Installation, Operating & Maintenance Instructions

Pendulum control & isolation valve
with Logic interface

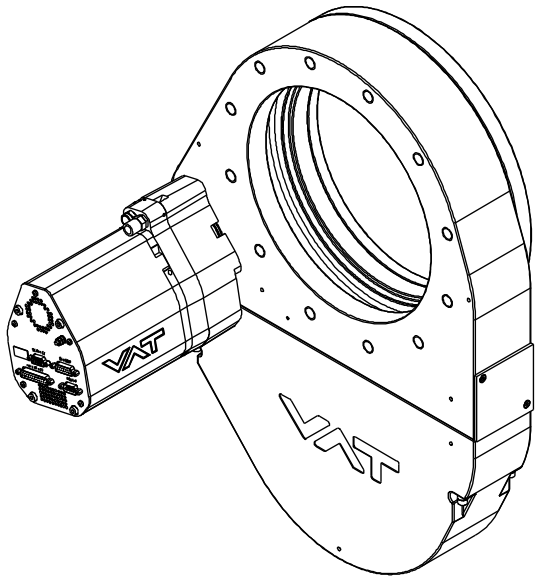
Series 650
DN 100-250 mm (I.D. 4” - 10")

This manual is valid for the valve ordering number(s):

650 . . - . .	**GC**	**- . . . .**	(1 sensor input)
650 . . - . .	**GE**	**- . . . .**	(2 sensor inputs)
650 . . - . .	**AC**	**- . . . .**	(1 sensor input / ±15V SPS)
650 . . - . .	**AE**	**- . . . .**	(2 sensor inputs / ±15V SPS)
650 . . - . .	**HC**	**- . . . .**	(1 sensor input / PFO)
650 . . - . .	**HE**	**- . . . .**	(2 sensor inputs / PFO)
650 . . - . .	**CC**	**- . . . .**	(1 sensor input / ±15V SPS / PFO)
650 . . - . .	**CE**	**- . . . .**	(2 sensor inputs / ±15V SPS / PFO)

SPS = Sensor Power Supply PFO = Power Failure Option

configured with firmware **650P.1E.05**



Sample picture

Imprint

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Publisher VAT Vakuumventile AG, CH-9469 Haag, Switzerland

Editor VAT Vakuumventile AG, CH-9469 Haag, Switzerland

Print VAT Vakuumventile AG, CH-9469 Haag, Switzerland

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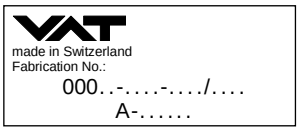
1 Description of product

1.1 Identification of product

The fabrication number and order number are fixed on the product directly or by means of an identification plate.



← Fabrication number
← Order number

1.2 Use of product

This product is a throttling pendulum valve with isolation functionality. It is intended to use for downstream pressure control applications.
Use product for clean and dry vacuum applications only. Other applications are only allowed with the written permission of VAT.

1.3 Used abbreviations

Abbreviation	Description
CPA	Control Performance Analyzer
CV	Control View
PFO	Power Failure Option
SFS	Sensor Full Scale
SPS	Sensor Power Supply
ADC	Analog-to-digital converter

1.4 Related documents

- Product Data Sheet
- Dimensional Drawing
- IOMI Heating device (if valve with heater)

1.5 Important information

This symbol points to a very important statement that requires particular attention.

Example:

Refer to chapter: «Technical data» for detailed information.

1.6 Technical data

1.6.1 Control and actuating unit

Description		
Power input [1] **(α)**	+24 VDC (±10%) @ 0.5 V pk-pk max.	[connector: POWER]
[650 . . - . . **A** . - . . . . / 650 . . - . . **G** . - . . . .] [650 . . - . . **C** . - . . . . / 650 . . - . . **H** . - . . . .]	50 W max. (operation of valve with max. load) without PFO [3] 50 W plus 10 W for PFO [3]	
Sensor power supply [2] **(β)** [650 . . - . . **A** . - . . . . / 650 . . - . . **C** . - . . . .] Input Output	 +24 VDC / 1500 mA max. ±15 VDC (±5%) / 1000 mA max.	 [connector: POWER] [connector: SENSOR]
Sensor power supply [2] **(β)** [650 . . - . . **G** . - . . . . / 650 . . - . . **H** . - . . . .] Input Output	 + 24 VDC resp. ± 15 VDC same as input but: 2.0 A max. at ± 15 VDC 1.5 A max. at + 24 VDC	 [connector: POWER] [connector: SENSOR]

1) Internal overcurrent protection by a PTC device.
2) Refer to chapter «Sensor supply concepts» for details.
3) PFO = Power Failure Option. Refer to «Behavior in case of power failure» for details.

Calculation of complete power consumption:
$P_{tot} = \alpha + \beta$
whereas β depends on sensor supply concept and sensor power consumption.

Control and actuating unit (continuation)				
Sensor input Signal input voltage ADC resolution Sampling time	0-10 VDC / Ri>100 kΩ [connector: SENSOR] 0.23 mV 10 ms			
Digital inputs [4]	±24 VDC max. [connector: INTERFACE]			
Digital outputs [4] Input voltage Input current Breaking capacity	[connector: INTERFACE] 70 VDC or 70 V peak max. 0.5 ADC or 0.5 A peak max. 10 W max.			
Analog outputs [4]	0-10 VDC / 1 mA max. [connector: INTERFACE]			
PFO [5] battery pack [650 . . - . . **C** . - . . . . / 650 . . - . . **H** . - . . . .] Charging time Durability	2 minutes max. up to 10 years @ 25°C ambient; refer to «Durability of power fail battery» for details			
Compressed air supply	4 - 7 bar / 55 - 100 psi (above ATM)			
Ambient temperature	0 °C to +50 °C max. (<35 °C recommended)			
Pressure control accuracy	5 mV or 0.1% of setpoint, whichever is greater			
	DN 100 **4"** (650**40** - ....)	**DN 160** **6"** (650**44** - ....)	**DN 200** **8"** (650**46** - ....)	**DN 250** **10"** (650**48** - ....)
Position resolution / position control capability	9155 steps (full stroke)	11111 steps (full stroke)	12266 steps (full stroke)	12533 steps (full stroke)
Closing time throttling only	0.7 s typ. (full stroke)	0.8 s typ. (full stroke)	0.9 s typ. (full stroke)	0.9 s typ. (full stroke)
Opening time throttling only	0.7 s typ. (full stroke)	0.8 s typ. (full stroke)	0.9 s typ. (full stroke)	0.9 s typ. (full stroke)
Closing time throttling & isolation	3 s typ. (full stroke)	3 s typ. (full stroke)	3 s typ. (full stroke)	3 s typ. (full stroke)
Opening time throttling & isolation	4 s typ. (full stroke)	4 s typ. (full stroke)	4 s typ. (full stroke)	4 s typ. (full stroke)

[4] Refer to chapter «Schematics» for details.

[5] PFO = Power Failure Option. Refer to chapter «Behavior in case of power failure» for details.

1.6.2 Valve unit

Description	
Pressure range at 20°C	
- Aluminum (650 . . - . **A** . . - . . . .)	1 × 10E-8 mbar to 1.2 bar (abs)
- Aluminum hard anodized (650 . . - . **H** . . - . . . .)	1 × 10E-6 mbar to 1.2 bar (abs)
- Aluminum nickel coated (650 . . - . **I** . . - . . . .)	1 × 10E-8 mbar to 1.2 bar (abs)
Leak rate to outside at 20°C	
- Aluminum (650 . . - . **A** . . - . . . .)	1 × 10E-9 mbar l/s
- Aluminum hard anodized (650 . . - . **H** . . - . . . .)	1 × 10E-5 mbar l/s
- Aluminum nickel coated (650 . . - . **I** . . - . . . .)	1 × 10E-9 mbar l/s
Leak rate valve seat at 20°C	
- Aluminum (650 . . - . **A** . . - . . . .)	1 x 10E-9 mbar l/s
- Aluminum hard anodized (650 . . - . **H** . . - . . . .)	1 x 10E-4 mbar l/s
- Aluminum nickel coated (650 . . - . **I** . . - . . . .)	1 x 10E-9 mbar l/s
Cycles until first service - Isolation cycles (open - closed - open) - Throttling cycles (open - max. throttle - open)	 200’000 (unheated and under clean conditions) 1’000’000 (unheated and under clean conditions)
Admissible operating temperature	+10°C to +120°C
Mounting position	any (valve seat on chamber side is recommended) (valve seat to face chamber is recommended)
Wetted materials	
- Body (650 . . - . **A** . . - . . . .)	Aluminum 3.2315 (AA6082)
- Body (650 . . - . **H** . . - . . . .)	Aluminum 3.2315 (AA6082) hard anodized
- Body (650 . . - . **I** . . - . . . .)	Aluminum 3.2315 (AA6082) nickel coated
- Pendulum plate (650 . . - . **A** . . - . . . .)	Aluminum 3.2315 (AA6082)
- Pendulum plate (650 . . - . **H** . . - . . . .)	Aluminum 3.2315 (AA6082) hard anodized
- Pendulum plate (650 . . - . **I** . . - . . . .)	Aluminum 3.2315 (AA6082) nickel coated
- Sealing ring (650 . . - . **A** . . - . . . .)	Aluminum 3.2315 (AA6082), 1.4306 (304L)
- Sealing ring (650 . . - . **H** . . - . . . .)	Aluminum 3.2315 (AA6082) hard anodized, 1.4306 (304L)
- Sealing ring (650 . . - . **I** . . - . . . .)	Aluminum 3.2315 (AA6082) nickel coated, 1.4306 (304L)
- Other parts	Stainless steel 316L (1.4404 or 1.4435), 1.4122, 1.4310 (301), 1.4303 (304), 1.4571, A2 (304)
- Seals	Viton® (standard). Other materials available. Seal materials are declared on dimensional drawing of specific valve ordering number.

Description (continuation)				
	DN 100 **4"** (650**40** - ....)	**DN 160** **6"** (650**44** - ....)	**DN 200** **8"** (650**46** - ....)	**DN 250** **10"** (650**48** - ....)
Max. differential pressure on plate during isolation	1200 mbar in either direction	1200 mbar in either direction	1200 mbar in either direction	1200 mbar in either direction
Max. differential pressure on plate during opening and throttling	30 mbar	10 mbar	5 mbar	5 mbar
Min. controllable conductance (N_2 molecular flow)	3 l/s	5 l/s	10 l/s	15 l/s
Dimensions	Refer to dimensional drawing of specific valve ordering number (available on request)			

2 Safety

2.1 Compulsory reading material

Read this chapter prior to performing any work with or on the product. It contains important information that is significant for your own personal safety. This chapter must have been read and understood by all persons who perform any kind of work with or on the product during any stage of its serviceable life.

NOTICE

Lack of knowledge

Failing to read this manual may result in property damage.

Firstly, read manual.

These Installation, Operating & Maintenance Instructions are an integral part of a comprehensive documentation belonging to a complete technical system. They must be stored together with the other documentation and accessible for anybody who is authorized to work with the system at any time.

2.2 Danger levels

⚠ DANGER

High risk

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Medium risk

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Low risk

Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Command

Indicates a hazardous situation which, if not avoided, may result in property damage.

2.3 Personnel qualifications

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

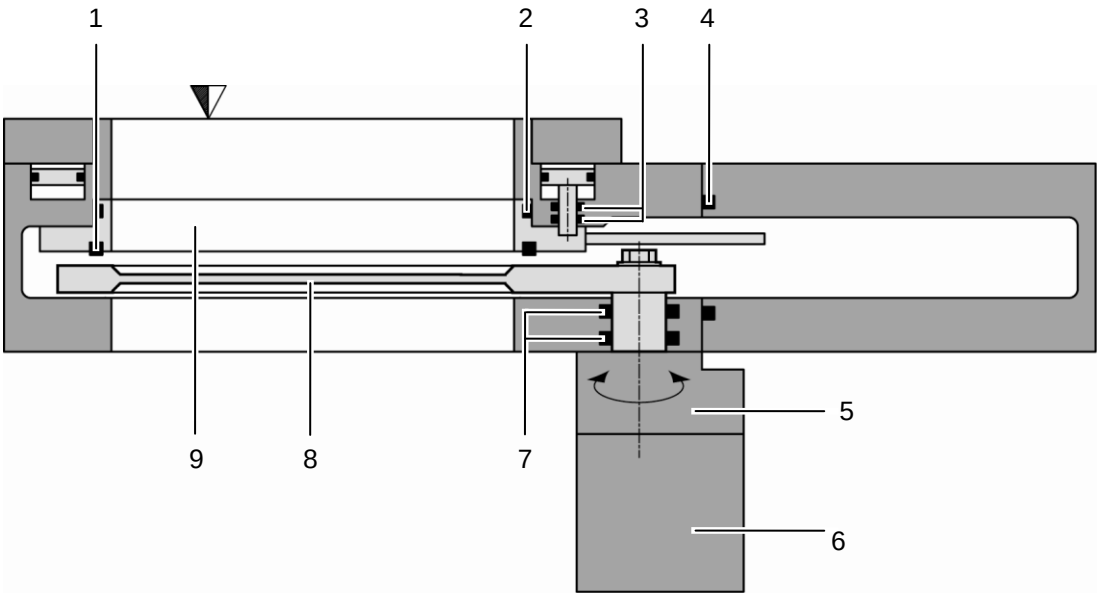
Only qualified personnel are allowed to carry out the described work.

2.4 Safety labels

Label	Part No.	Location on valve
	T-9001-156	On protective foil covering of valve opening

3 Design and Function

3.1 Design

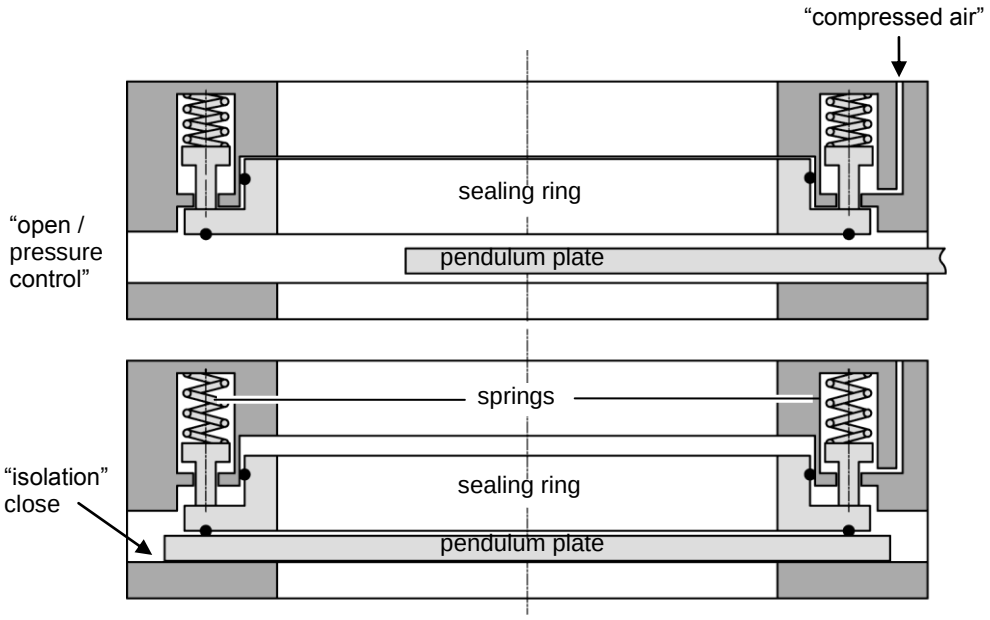


1	Plate seal	6	Integrated controller
2	Body seal	7	Rotary feed through seals
3	Shaft feed through seals	8	Pendulum plate
4	Bonnet seal	9	Sealing ring
5	Actuator		

3.2 Function

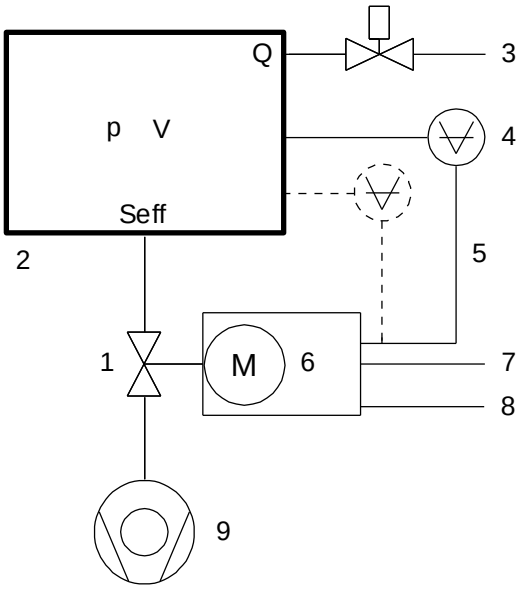
The valve plate acts, due to its pendulum motion, as a throttling element and varies the conductance of the valve opening. The integrated controller calculates the required plate position to achieve the set point pressure. Actuation is performed by a stepper motor. An encoder monitors the position. This principle ensures fast and accurate process pressure control.

For opening or control the “sealing ring” is lifted pneumatically by “compressed air”, afterwards the “pendulum plate” moves to open or do pressure control. For leak tight closing, the “sealing ring” moves downwards and press the pendulum plate to valve body for “isolation”. Closing is performed by “springs”.



3.2.1 Pressure control system overview and function

Vacuum pressures are always absolute pressures unless explicitly specified as pressure differences.



Example: Downstream control

1 Valve
2 Process chamber
3 Gas inlet
4 Pressure sensor(s)
5 Sensor cable
6 Controller and actuator
7 Cable to remote control unit
8 Cable to power supply
9 HV Pump

S_{eff} Q / p
S_{eff} effective pump speed (ls^{-1})
Q Gas flow (mbar)
p Pressure (mbar)

or units used in USA
S_{eff} = 12.7 • Q / p
S_{eff} effective pump speed (ls^{-1})
Q Gas flow (sccm)
p Pressure (mTorr)

3.2.1.1 Way of operation

The controller compares the actual pressure in the process chamber given by the pressure sensor with the preset pressure. The controller uses the difference between actual and set pressure to calculate the correct position of the control valve. The controller drives the control valve into the correct position and the actual pressure again equals the set pressure.
This control operation is performed continuously. Pressure changes in the process chamber due to leaks, desorption, and gas flow, reaction products, variations in pumping speed etc. are always corrected at once.

3.2.1.2 Pressure control

In a vacuum system which is pumped and into which gas is admitted at the same time, the pressure can be controlled in two ways:

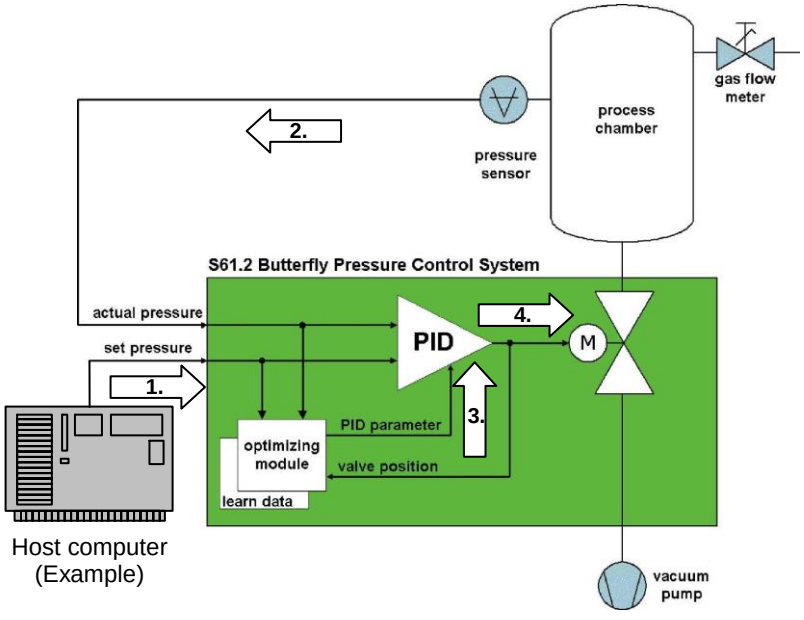
1. Downstream control (standard):
   The pressure is controlled by changing the conductance of a control valve between pump and process chamber. This changes the effective pumping speed at the process chamber. Pressure and gas flow can be independently controlled over a wide range.

2. Upstream control:
   The pressure is controlled by changing the gas flow into the process chamber, while the pumping speed remains constant.

3.2.1.3 Adaptive controller (standard)

A controller adapting itself to changes in pressure, gas flow and pumping speed without any manual adjustments. This allows for a completely automatic operation of the system.

3.2.2 Principle of a pressure control system



1. Host computer sends pressure set point
2. Controller reads actual pressure from sensor
3. Optimizing module sends new PID parameters
4. Actuator sets new valve position

4 Installation

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

4.1 Unpacking

NOTICE

Physical overstraining at controller

Inappropriate handling with the valve may cause in damage of controller.

Do not place the valve on the controller.

⚠ CAUTION

Valve is a heavy component

Physical overstraining.

Use a crane to lift valves DN 200 (8”) and larger.

- Make sure that the supplied products are in accordance with your order.
- Inspect the quality of the supplied products visually. If it does not meet your requirements, please contact VAT immediately.
- Store the original packaging material. It may be useful if products must be returned to VAT.

1. Open the transport case and remove inside packing material as far as necessary.
2. Attach lifting device for valves DN 200 (8”) and larger. For attachment refer to dimensional drawing of valve.
3. Lift the valve carefully and place it on a clean place.

Do not remove protective foils from valve opening

4.2 Installation into the system

⚠ WARNING

Valve opening

Risk of serious injury.

Human body parts must be kept out of the valve opening and away from moving parts. Do not connect the controller to power before the valve is installed complete into the system.

⚠ WARNING

Valve in open position

Risk of injury when compressed air is connected to the valve.

Connect compressed air only when:
– valve is installed in the vacuum system
– moving parts cannot be touched

NOTICE

Sealing surfaces

Sealing surfaces of valve and vacuum system could be damage in case of incorrect handling.

Only qualified personal are allowed to install the valve into the vacuum system.

NOTICE

Wrong connection

Wrong connection may result in damage of controller or power supply.

Connect all cables exactly as shown in the following descriptions and schematics.

NOTICE

Burned connector pins (spark)

Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

NOTICE

Contamination

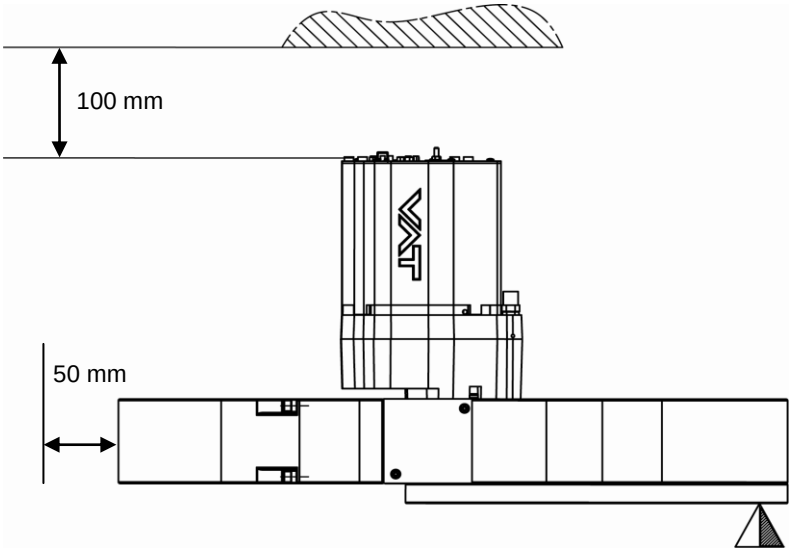
Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

Mount valve to a clean system only.

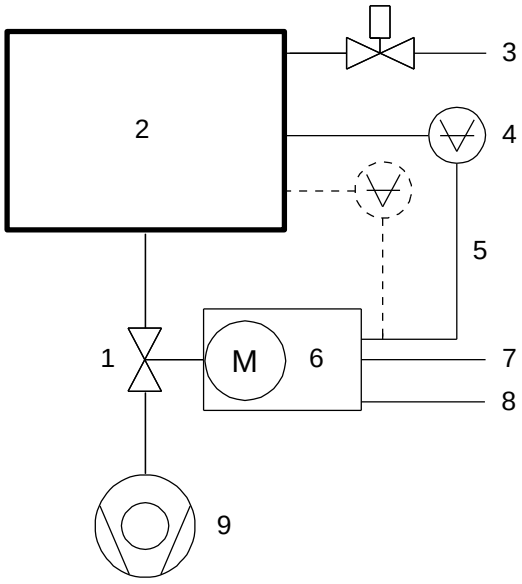
4.2.1 Installation space condition

Install the valve with integrated controller with space for dismantling and air circulation as shown in figure below.



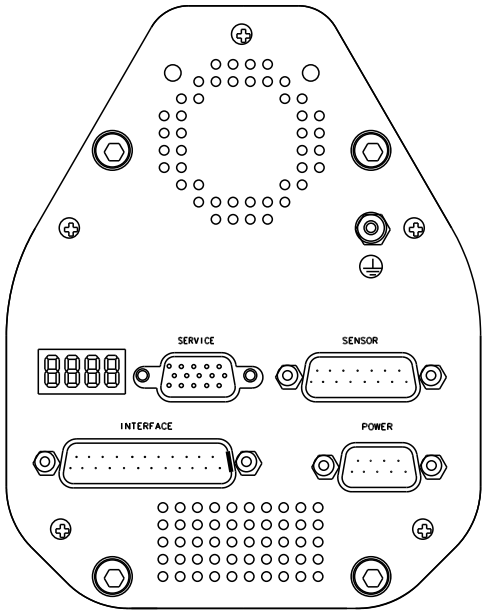
4.2.2 Connection overview

System:



1 Valve
2 Process chamber
3 Gas inlet
4 Pressure sensor(s)
5 Sensor cable(s)
6 Controller and actuator
7 Cable to remote control unit
8 Cable to power supply
9 Pump

Controller:



4.2.3 Installation procedure

1. Install valve [1] into the vacuum system. Valve seat side should face process chamber. The valve seat side is indicated by the symbol "∇" on the valve flange.

- Do not tighten the flange screws stronger than indicated under «Tightening torque».
- Do not admit higher forces to the valve than indicated under «Admissible forces».
- Make sure that enough space is kept free to do preventive maintenance work. The required space is indicated on the dimensional drawing.

2. Connect compressed air supply to connection labeled '**IN**' located at actuator, see Figure 1 below. Connect compressed air return line connection labeled '**OUT**' located at actuator, see Figure 1 below.

- Compressed air pressure must be in the range of: **4 - 7 bar / 55 - 100 psi (above ATM)**.
- Use only clean, dry or slightly oiled air. IN / OUT connections are 1/8" ISO/NPT internal threads.

3. Install the ground connection cable at controller. Refer to «Electrical connection»

4. Install pressure sensor(s) [2] according to the recommendations of the sensor manufacturer and directives given under «Requirements to sensor connection».

5. Connect sensor cable [3] to sensor(s) and then to valve (connector: SENSOR). Refer to chapter «Electrical connection» for correct wiring.

Input for second sensor is available on 650 . . - . . . E - . . . . version only.

6. Connect valve to Logic [4] (connector: INTERFACE). Refer to «Logic schematics» for correct wiring.

7. Connect power supply [5] to valve (connector: POWER). Refer to chapter «Electrical connection» for correct wiring.

To provide power to the valve motor pins 4 and 8 must be bridged, otherwise motor interlock is active and the valve enters the safety mode and is not operative. Refer also to «Safety mode».

8. This valve has a double sealed rotary feedthrough and optionally an intermediate pumping port for the actuator shaft. This port (1/8" ISO/NPT) could be connected to the vacuum line, see Figure 2 below.

9. This valve may optionally be equipped with a heating device. Connect VAT heating device according to manual of respective heating device.

10. Perform «Setup procedure» to prepare valve for operation.

Without performing the setup procedure the valve will not be able to do pressure control.

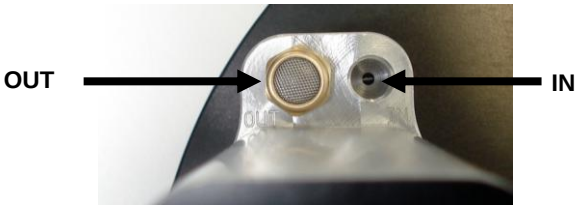


Fig. 1

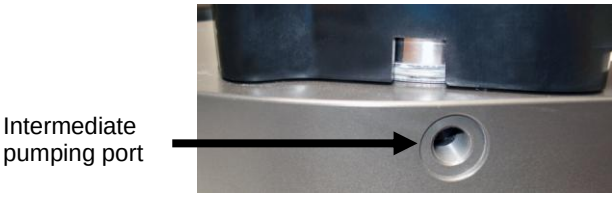


Fig. 2

4.3 Tightening torque

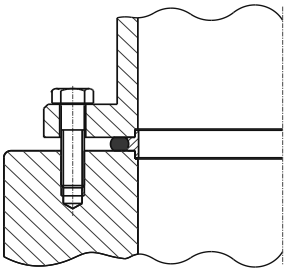
The torque values below are dependent on many factors, such as materials involved, surface quality, surface treatment, and lubrication.

The torques below are valid if immersion depth of the mounting screws is at least once the thread diameter (min. 1d), and the friction coefficient of the screw-flange connection ($\mu_{total} = (\mu_{screw\ thread\text{-}helicoil} + \mu_{under\ screw\ head})/2$) is bigger than 0.12. Lower friction coefficients may damage the valve, as the resulting preload force gets too high. Therefore for other friction coefficients the torque needs to be adapted. Please review design guidelines for Helicoil-Screw connections and make sure that screws in use are capable to withstand applied torques, are appropriate for the application and are not too long. Too long screws may damage the valve, the immersion depth should not exceed (hole depth – 1 mm).

Tighten mounting screws of the flanges uniformly in crosswise order. Observe the maximum torque levels in the following tables.

4.3.1 Mounting with centering rings

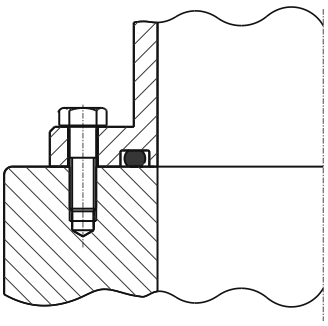
Valve size	ISO-F	ISO-F
	max. tightening torque (Nm)	**max. tightening torque (lbs . ft)**
DN100 / 4“ (650**40** - . . . . - . . . .)	8-10	6-8
DN160 / 6“ (650**44** - . . . . - . . . .)	13-15	9-11
DN200 / 8“ (650**46** - . . . . - . . . .)	13-15	9-11
DN250 / 10“ (650**48** - . . . . - . . . .)	17-20	13-15
	hole depth (mm)	**hole depth (inch)**
DN100 / 4“ (650**40** - . . . . - . . . .)	12	0.47
DN160 / 6“ (650**44** - . . . . - . . . .)	14	0.55
DN200 / 8“ (650**46** - . . . . - . . . .)	15	0.59
DN250 / 10“ (650**48** - . . . . - . . . .)	16	0.63



Refer to «Spare parts / Accessories» for centering rings ordering numbers.

4.3.2 Mounting with O-ring in grooves

Valve size	ISO-F	JIS	ASA-LP	ISO-F	JIS	ASA-LP
	max. tightening torque (Nm)			max. tightening torque (lbs . ft)		
DN100 / 4“ (650**40** - . . . . - . . . .)	20-23	35-40	35-40	15-17	26-30	26-30
DN160 / 6“ (650**44** - . . . . - . . . .)	35-40	35-40	35-40	26-30	26-30	26-30
DN200 / 8“ (650**46** - . . . . - . . . .)	35-40	35-40	80-90	26-30	26-30	59-67
DN250 / 10“ (650**48** - . . . . - . . . .)	35-41	65-70	80-90	26-30	48-52	59-67
	hole depth (mm)			hole depth (inch)		
DN100 / 4“ (650**40** - . . . . - . . . .)	12	12	12	0.47	0.47	0.47
DN160 / 6“ (650**44** - . . . . - . . . .)	14	14	14	0.55	0.55	0.55
DN200 / 8“ (650**46** - . . . . - . . . .)	15	15	14	0.59	0.59	0.59
DN250 / 10“ (650**48** - . . . . - . . . .)	16	16	16	0.63	0.63	0.63



Tighten mounting screws of the flanges uniformly in crosswise order. Observe the maximum torque levels in the following table. Higher tightening torques deforms the valve body and may lead to malfunction of the valve.

4.3.3 Admissible forces

NOTICE

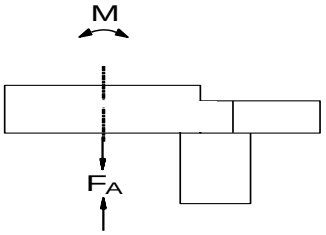
Force at valve body

Forces from evacuating the system, from the weight of other components, and from baking can lead to deformation and malfunctioning of the valve.

Do not higher force the valve body as specified.

The following forces are admissible.

Valve size	Axial tensile or compressive force «F_A»		Bending moment «M»	
	N	lb.	Nm	lbf.
DN100 / 4“ (650**40** - . . . . - . . . .)	1000	220	40	30
DN160 / 6“ (650**44** - . . . . - . . . .)	2000	440	80	60
DN200 / 8“ (650**46** - . . . . - . . . .)	2000	440	80	60
DN250 / 10“ (650**48** - . . . . - . . . .)	2500	550	100	75
For a combination of both forces (F_A and M) the values are invalid. Verify that the depth of the mounting screws is min. 1 x thread diameter. Please contact VAT for more information.				

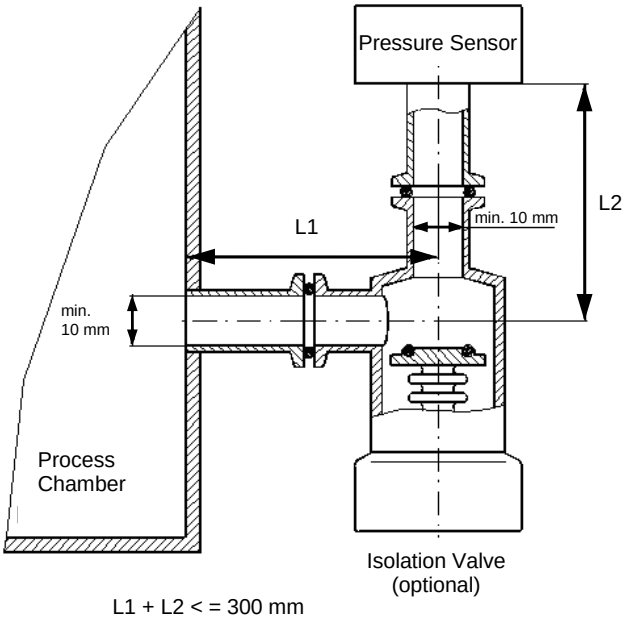


4.3.4 Requirements to sensor connection

To achieve fast and accurate pressure control a fast sensor response is required. Sensor response time: < 50ms. The sensor is normally connected to the chamber by a pipe. To maintain that the response time is not degraded by this connection it needs to meet the following requirements:

- Inner diameter of connection pipe: **> = 10 mm**
- Length of connection pipe: **< = 300 mm**

These conductance guidelines must include all valves and limiting orifices that may also be present. Make also sure that there is no obstruction in front of sensor connection port inside the chamber. The sensor should also be mounted free of mechanical shock and vibration. Dynamic stray magnetic fields may introduce noise to sensor output and should be avoided or shielded.



L1 + L2 < = 300 mm

4.4 Electrical connection

NOTICE

Wrong connection

Wrong connection may result in damage of controller or power supply.

Connect all cables exactly as shown in the following descriptions and schematics.

NOTICE

Burned connector pins (spark)

Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

4.4.1 Sensor supply concepts

This valve offers 3 alternative concepts to supply the sensor(s) with power. This depends on the sensor type and valve version that is used. This valve is available with an optional sensor power supply module (SPS) that converts ±15 VDC from the 24 VDC.

Concepts:

- External +24 VDC supplied to POWER connector is feedthrough to SENSOR connector to supply 24 VDC sensors. Refer to chapter «Power and sensor connection (+24 VDC sensors)» for schematic and correct wiring.
- External ±15 VDC supplied to POWER connector is feedthrough to SENSOR connector to supply ±15 VDC sensors. Refer to chapter «Power and sensor connection (±15 VDC sensors) without optional SPS module» for schematic and correct wiring.
- External +24 VDC supplied to POWER connector is converted into ±15 VDC by the valve internal SPS and supplied to SENSOR connector to supply ±15 VDC sensors. Refer to chapter «Power and sensor connection (±15 VDC sensors) with optional SPS module» for schematic and correct wiring.

This concept is only possible when SPS retrofit is installed.

Valve versions:

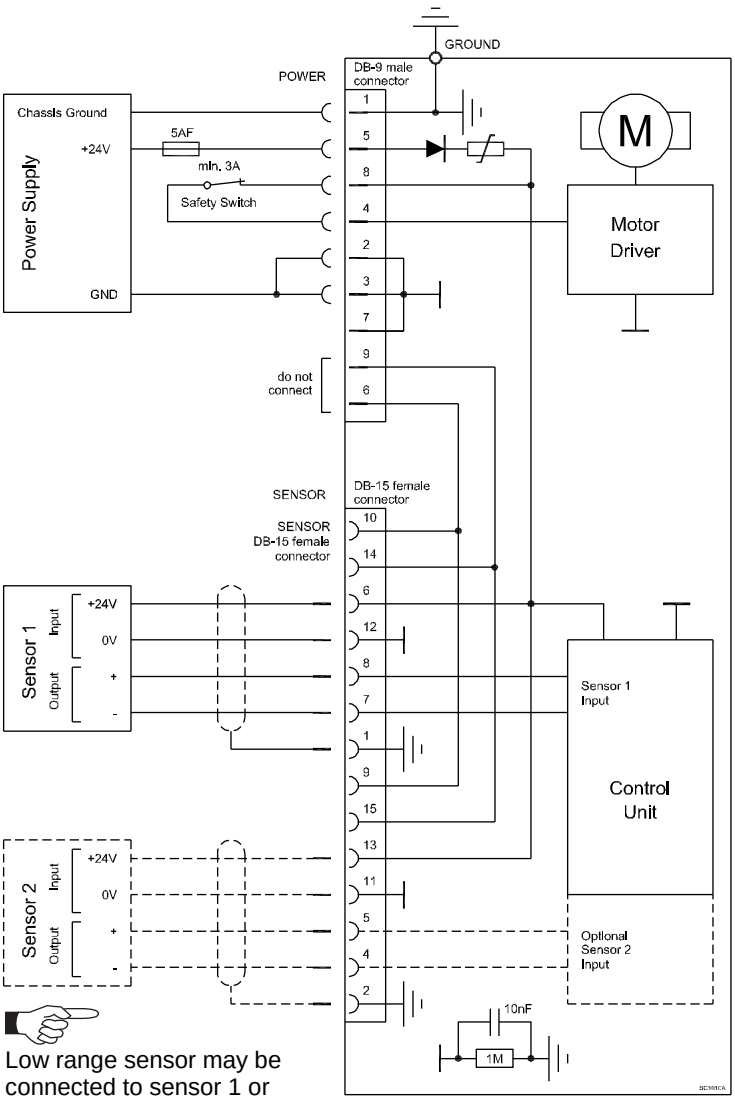
- 650. . - . . **G** . - . . . . and 650 . . - . . **H** . - . . . . SPS module not included
- 650 . . - . . **A** . - . . . . and 650 . . - . . **C** . - . . . . SPS module included

The SPS module can be retrofitted. Refer to chapter «Retrofit / replacement procedure» for instruction.

4.4.2 Power and sensor connection (+24 VDC sensors)

[650 . . - . . **G** . - . . . . / 650 . . - . . **H** . - . . . . versions recommended]

4.4.2.1 Sensor power wiring via controller

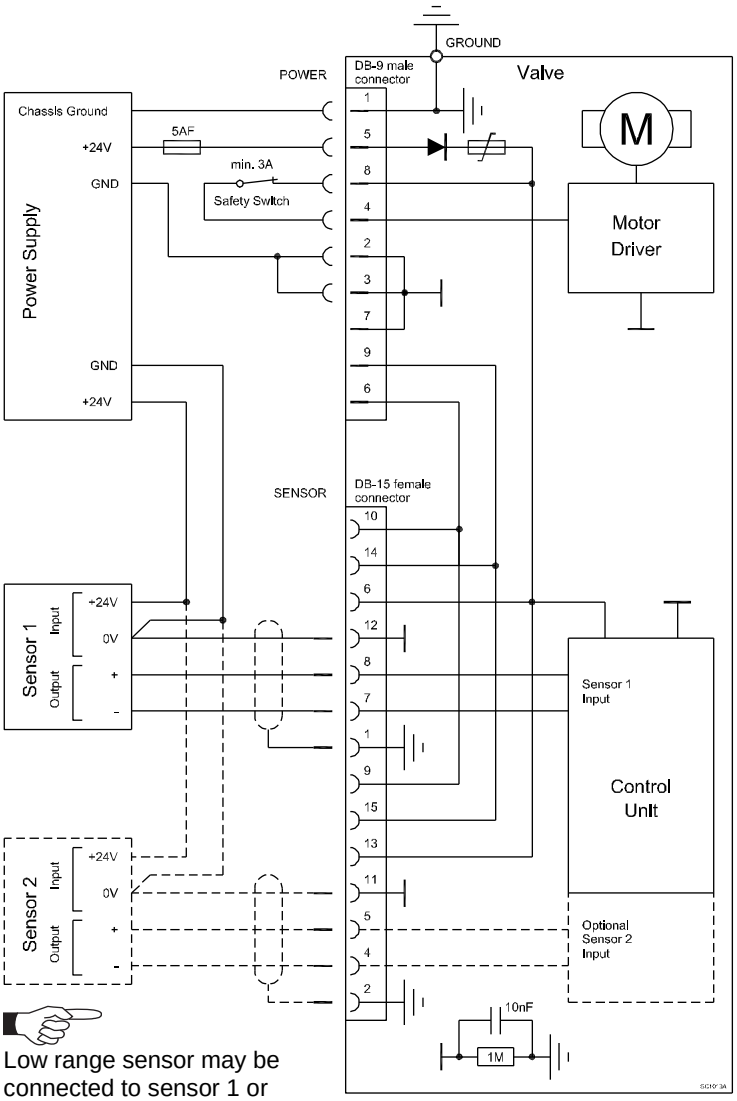


Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+24V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

4.4.2.2 Sensor power wiring external



Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

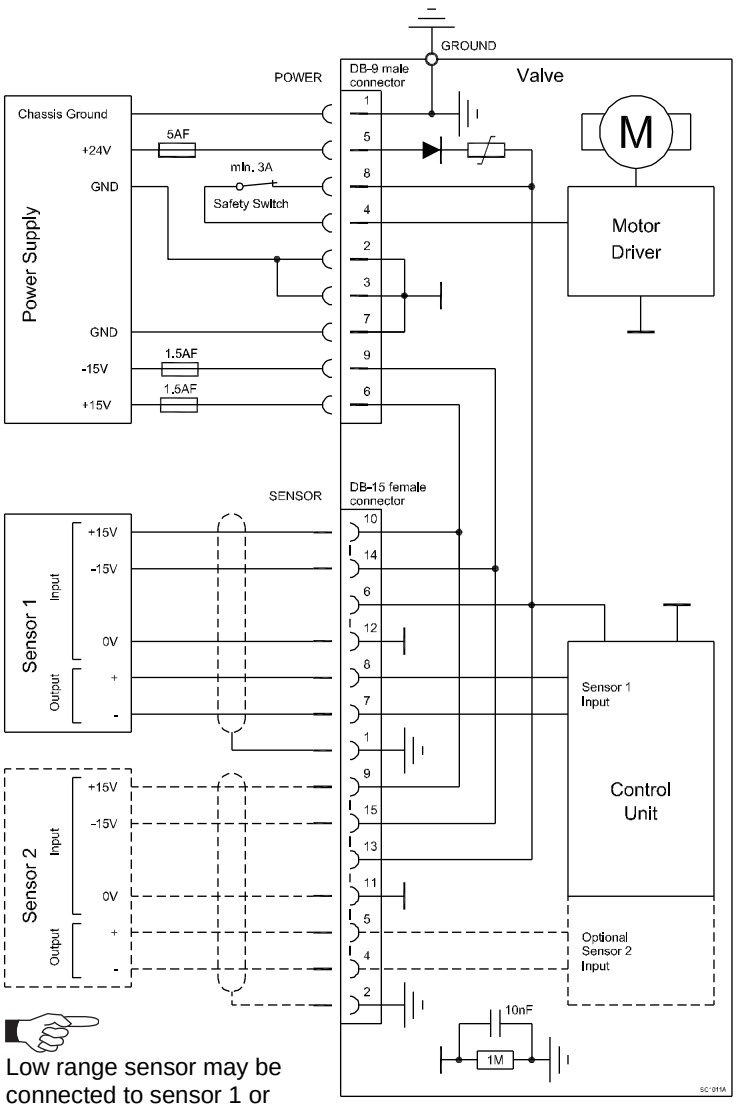
Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+24V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

4.4.3 Power and sensor connection (±15 VDC sensors) without opt. SPS module

[650 . . - . . G . - . . . . / 650 . . - . . H . - . . . . versions only]

4.4.3.1 Sensor power wiring via controller

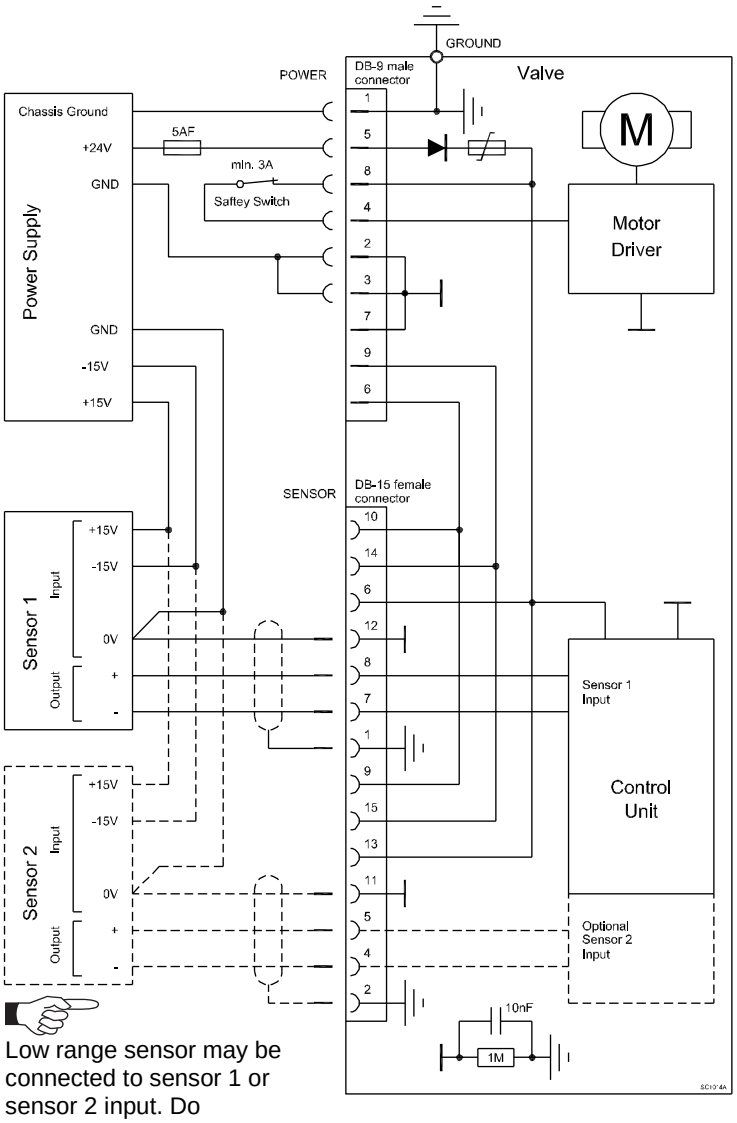


Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND and GND / -15V / +15V) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

4.4.3.2 Sensor power wiring external



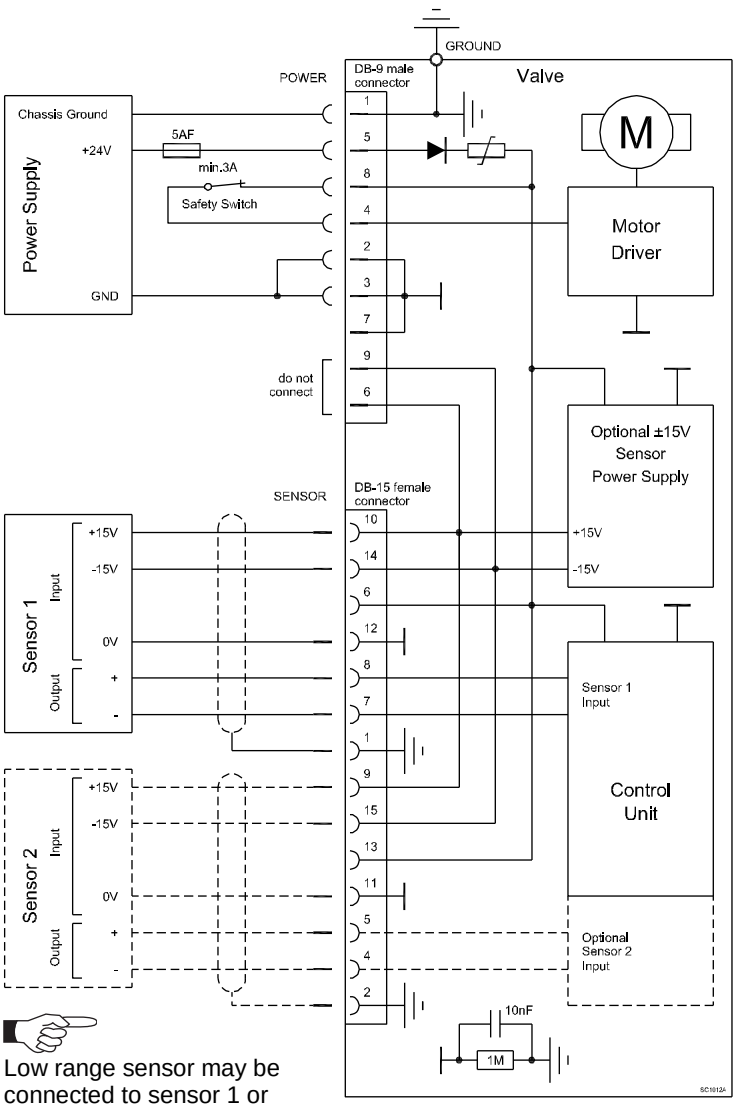
Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

4.4.4 Power and sensor connection (±15 VDC sensors) with optional SPS module

[650 . . - . . **A** . - . . . . / 650 . . - . . **C** . - . . . . versions only]



Pins 4 and 8 must be bridged for operation. An optional switch would allow for motor interlock to prevent valve from moving.

Low range sensor may be connected to sensor 1 or sensor 2 input. Do configuration accordingly.

- Use shielded sensor cable(s). Keep cable as short as possible, but locate it away from noise sources.
- Connect Power supply (+24 / GND) at DB–9 male power connector and Sensors (+15V / -15V / 0V / + / -) at DB–15 female sensor connector exactly as shown in the drawing above!
- Connector: Use only screws with 4–40 UNC thread for fastening the connectors!

4.4.5 Logic interface connection

Refer to chapter: «Function and Wiring» for wiring information.

4.4.6 Service port connection

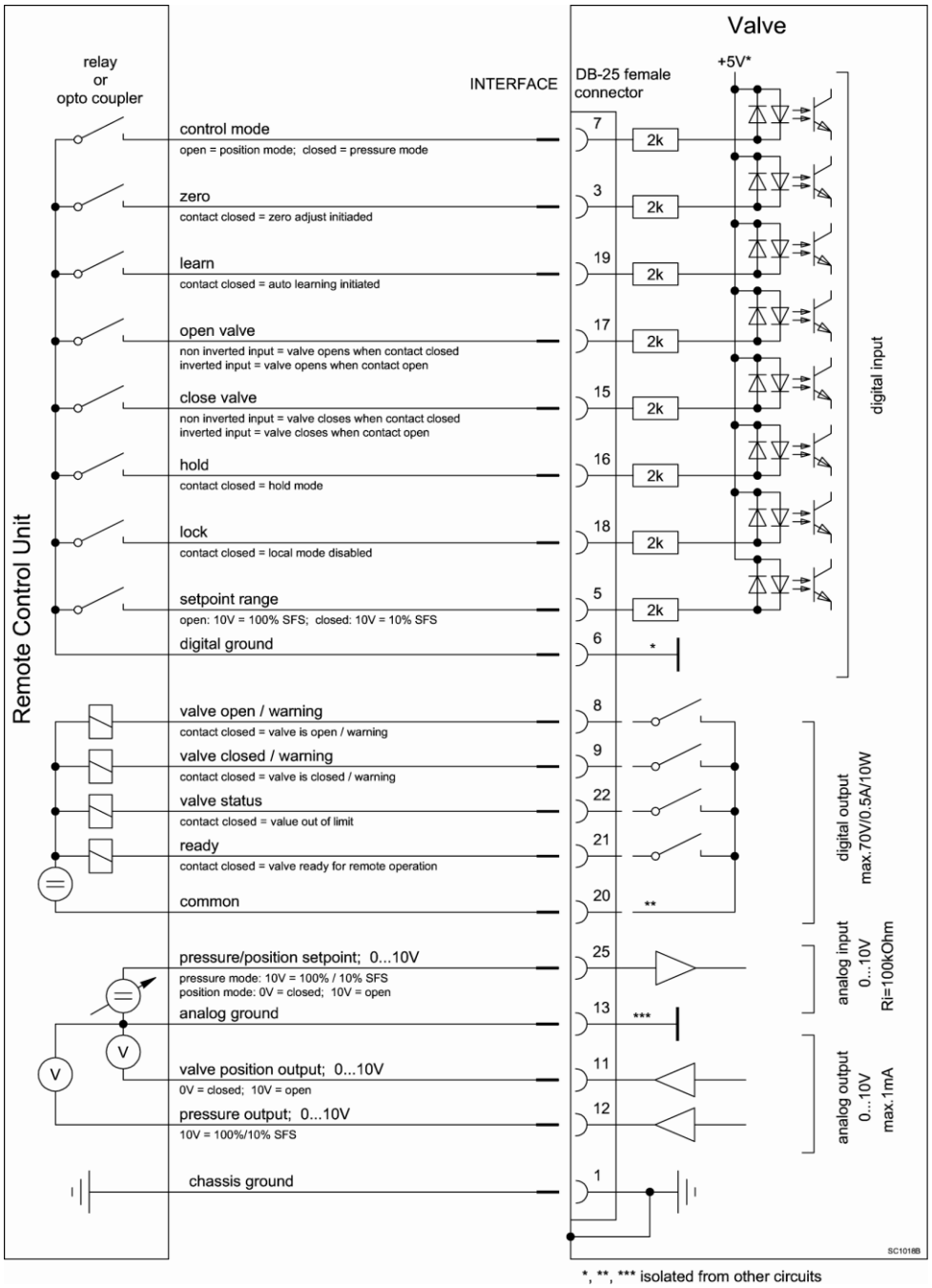
The service port (connector: SERVICE) allows to connect the valve to a RS232 port of a computer. This requires a service cable and software from VAT. You can either use our freeware 'Control View', which can be downloaded from www.vatvalve.com or purchase our 'Control Performance Analyzer'. Alternatively the VAT Service Box2 can be connected to the service port for setup and local operation. The service port is not galvanic isolated. Therefore we recommend using this only for setup, testing and maintenance and not for permanent control.
Refer also to chapter: «Local Operation» for details and to chapter «Spare parts / Accessories» for ordering numbers of service cable, software and Service Box 2.

Use only screws with 4–40 UNC thread for fastening the service port connector.

4.4.7 Function and Wiring

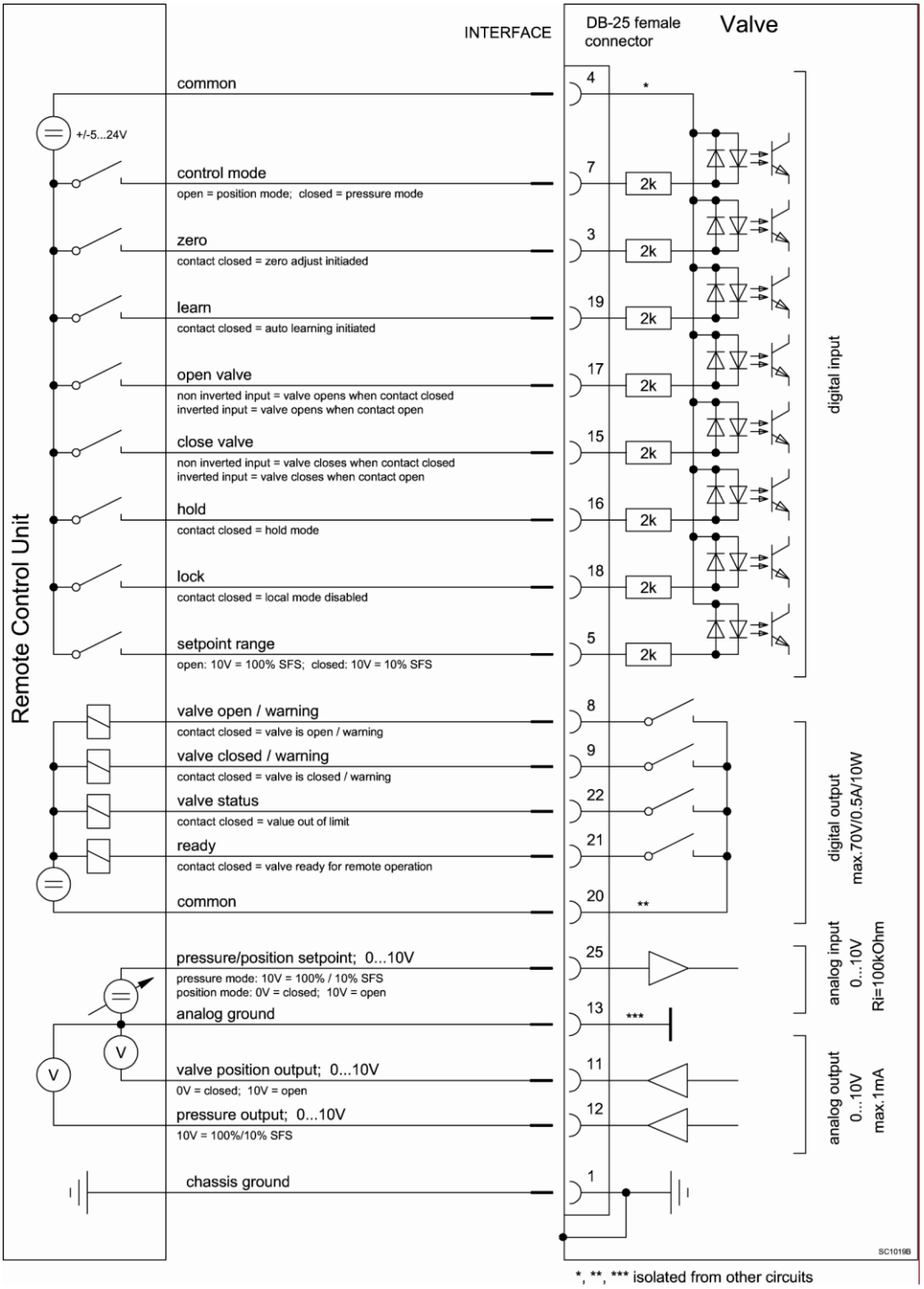
Logic interface allows for remote operation by means of digital and analog signals.
Digital inputs may be operated either by switches or by voltage sources.

a) Configuration with switches for digital inputs:



Do not connect other pins than indicated in the schematics above!
Use only screws with 4-40UNC thread for fastening the DB-25 connector!

b) Configuration with voltage source for digital inputs:



Do not connect other pins than indicated in the schematics above!
Use only screws with 4-40UNC thread for fastening the DB-25 connector!

4.4.8 Digital inputs

Pin	Function	Signal type	Description	Priority
7	**CONTROL MODE**	Digital Input [1]	This pin selects the control mode. This valve may either be operated as pressure controller or as position controller. PRESSURE CONTROL is activated as long as optocoupler is 'on'. The PID controller controls the chamber pressure according to the pressure SETPOINT by means of the valve position. POSITION CONTROL is activated when optocoupler is 'off'. The valve position is directly controlled according to the position SETPOINT.	6 [2]
5	**SETPOINT RANGE**	Digital input [1]	This pin selects the SETPOINT RANGE. Low range extension is activated as long as optocoupler is 'on'. It's effective in pressure control mode only. This function extends the lower 10% range of sensor full scale (SFS) to the full 0-10V for SETPOINT input. Herewith you can achieve better resolution, especially in case of a 2 sensor system. Example with SFS = 100mTorr: Not active (10V=100%) >> 10V setpoint = 100mTorr Active (10V=10%): >> 10V setpoint = 10mTorr	N/A
16	**HOLD**	Digital input [1]	This function stops the valve at the current position. After release of the signal the valve will return to the selected CONTROL MODE. Only PRESSURE or POSITION Mode. This function is activated as long as optocoupler is 'on'.	5 [2]
17	**OPEN VALVE**	Digital input [1]	This function will open the valve. This function is activated as long as optocoupler is 'on' in **non inverted** configuration. This function is activated as long as optocoupler is 'off' in **inverted** configuration. Configuration can be done in local operation via service port. Default settings is not inverted	3 [2]
15	**CLOSE VALVE**	Digital input [1]	This function will close the valve. This function is activated as long as optocoupler is 'on' in **non inverted** configuration. This function is activated as long as optocoupler is 'off' in **inverted** configuration. Configuration can be done in local operation via service port. Default settings is not inverted	2 [2]

1) All digital inputs are digitally filtered. Filter delay is 50ms. This means that digital signals must be applied for at least 50ms to be effective. Refer to «Function and wiring» for details about input circuit.

2) Highest priority is 1. Functions with lower priorities will not be effective as long as higher priority functions are active.

Pin	Function	Signal type	Description	Priority
3	**ZERO**	Digital Input [1]	This function compensates the pressure gauge offset voltage and sets the pressure value to zero. In case of a 2 sensor system both sensor inputs will be adjusted. This function is initiated by the 'off' to 'on' transition of the optocoupler. If 'on' remains established this will not re-initiate the function and does also not block functions with lower priorities. Do not perform ZERO as long as pressure gauge voltage is shifting. Do not perform ZERO, if the base pressure of your vacuum system is higher than 1%o of sensor full scale. We recommend disabling ZERO function in this case. You can disable the function in local operation via service port.	1 [2]
19	**LEARN**	Digital Input [1]	The LEARN routine determines the control characteristic of the vacuum system. This function is initiated by the 'off' to 'on' transition of the optocoupler. A transition from 'on' to 'off' while the routine is running would stop it. While running, the routine may not be interrupted by another function with higher priority. If 'on' remains established after completion this will not re-initiate the function and does also not block functions with lower priorities. Without a LEARN data set the PID controller is not able to perform pressure control.	4 [2]
18	**LOCK**	Digital input [1]	This function locks the valve in remote operation. In case the valve is in local operation it will turn to remote operation. Local operation via service port is not possible when LOCK is activated. When the signal is released the valve remains in remote operation but local operation may be activated via service port.	N/A
6	**DIGITAL GROUND**	Digital ground	Ground for all digital inputs. Ground is used when digital inputs are operated by switches. Connect switches to ground. Refer also to «Function and wiring» configuration a).	
4	**DIGITAL COMMON**	Digital common	Common for all digital inputs. Common is used when digital inputs are driven by voltage sources. Connect + or – terminal of source with common (input optocouplers are capable of bidirectional operation). Refer also to «Function and wiring» configuration b).	

1) All digital inputs are digitally filtered. Filter delay is 50ms. This means that digital signals must be applied for at least 50ms to be effective. Refer to «Function and wiring» for details about input circuit.

2) Highest priority is 1. Functions with lower priorities will not be effective as long as higher priority functions are active.

4.4.9 Digital outputs

Pin	Function	Signal type	Description
8	**VALVE OPEN or SERVICE REQUEST**	Digital output[1)]	This output is active in all operation modes and indicates either that the valve is open or that a service is requested. A service request is indicated when the valve requires cleaning due to contamination. Configuration of the functionality of this output can be done in local operation via service port. By default the output indicates open
9	**VALVE CLOSED or SERVICE REQUEST**	Digital output[1)]	This output is active in all operation modes and indicates either that the valve is close or that a service is requested. A service request is indicated when the valve requires cleaning due to contamination. Configuration of the functionality of this output can be done in local operation via service port. By default the output indicates close
22	**VALVE STATUS**	Digital output[1)]	The meaning of this output depends on the operation mode. LEARN: LEARN is not completed yet. PRESSURE CONTROL: Actual pressure is out of ±2% range of SETPOINT POSTION CONTROL: Actual position is out of ±0.1% range of SETPOINT
21	**READY**	Digital output[1)]	This signal indicates that the valve is ready for remote operation. If this signal is not active the valve is in one of the following modes: • Synchronization during power up • Local operation via service port • Safety mode. Refer to «Safety mode» for details.
20	**COMMON**	Digital common	Common for all digital outputs.

1) Refer to «Function and wiring» for details about output circuit.

4.4.10 Analog inputs and outputs

Pin	Function	Signal type	Description
25	**SETPOINT**	Analog input[1)]	The meaning of the setpoint input depends on the operation mode. LEARN: A voltage of 0-10V shall be applied to this input as pressure limit for learn. The limit pressure is in linear relation to the applied voltage. 10V relates to sensor full scale. In case of 2 sensor operation 10V relates to sensor 1 full scale (high range). To activate pressure limit function for remote operation it must be configured accordingly. Refer to «Interface configuration» PRESSURE CONTROL: A voltage of 0-10V shall be applied to this input as pressure setpoint. The pressure setpoint is in linear relation to the applied voltage. Depending on selected SETPOINT RANGE 10V means either sensor full scale or 10% of sensor full scale. In case of 2 sensor operation 10V relates to sensor 1 full scale (high range). POSITION CONTROL: A voltage of 0-10V shall be applied to this input as position setpoint. The position setpoint is in linear relation to the applied voltage. 0V is closed but not isolation function and 10V is open position. (Use digital input for isolation function)
12	**PRESSURE**	Analog output[1)]	This output indicates the current pressure as 0-10V. The output voltage is in linear relation to the pressure. Depending on the selected SETPOINT RANGE 10V means either sensor full scale or 10% of sensor full scale. In case of 2 sensor operation sensor full scale relates to sensor 1 (high range).
11	**POSITION**	Analog output[1)]	This output indicates the current valve position as 0-10V voltage range. The voltage is in linear relation to the valve position. 0V is closed but not isolation function and 10V is open position. (Use digital output for isolation function)
13	**ANALOG GROUND**	Analog ground	Ground for analog input and analog outputs.
1	**CHASSIS GROUND**	Chassis ground	Chassis ground connected to case. Shall be used to connect cable shield.

1) Refer to «Function and wiring» for details about input / output circuit.

4.5 Initial operation

4.5.1 Setup procedure

To enable the valve for **pressure control** setup **steps 1 to 6 must be performed**.
In case position control is required only it's sufficient to perform steps 1 to 3.

Setup steps		Description
1	**Power up**	Turn on external + 24VDC power supply of valve (and external ±15 VDC for sensor power supply if required). Refer to chapter «Behavior during power up» for details.
2	**Interface configuration**	Refer to chapter «Interface configuration» for details.
3	**Valve configuration**	Basic configurations of valve must be adapted according to application needs. Refer to chapter «Valve configuration» for details.
4	**Sensor configuration**	Basic configurations of sensor(s) must be adapted according to application needs. Refer to chapter «Sensor configuration» for details.
5	**ZERO**	Compensation of the sensor offset voltage. Refer to chapter «ZERO» for details.
6	**LEARN**	Determination of the vacuum system characteristic to accommodate the PID controller. Refer to chapter «LEARN» for details.

Without LEARN the valve is not able to run pressure control.

4.5.2 Interface configuration

Interface configuration must be adapted according to application needs.

Default configuration:

OPEN input	CLOSE input	OPEN output	CLOSE output
not inverted	not inverted	open	close

- Functionality of digital inputs CLOSE VALVE and OPEN VALVE must be selected.
  These may be configured as 'not inverted' or 'inverted'. Default is 'not inverted'.
- LEARN range configuration for remote operation must be selected.
  This may either be 'full range' or pressure limit according of analog SETPOINT input. Default is 'full range'.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**:
Do configuration in menu 'Setup / Interface'.	It's not possible to do 'Interface configuration' via remote operation.

4.5.3 Valve configuration

Basic valve configuration must be adapted according to application needs.

Definition of valve plate position in case of:

- **After power up**, default is 'close'.
- **Power failure**, default is 'not defined'. Only for versions that have Power Fail Option equipped [650 . . - . . **C** . - . . . or 650 . . - . . **H** . - . . .].
- **Network failure**, default setting refer to individual product data sheet.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**:
1. Do power up configuration in menu 'Setup / Valve'.	**Note:** It's not possible to do 'Valve configuration' via remote operation.
2. Do power fail configuration in menu 'Setup / Valve'.	

4.5.4 Sensor configuration

Basic sensor configuration must be adapted according to application needs.

- ZERO function: This may be 'disabled' or 'enabled'. Default is 'enabled'. Refer also to chapter «ZERO».
- Sensor configuration for 2 sensors version [650 . . - . . . **E** - . . . .]. Refer also to chapter: «Pressure control operation with 2 sensors».

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**:
1. Enable or disable ZERO function in menu 'Setup / Sensor'.	**Note:** It's not possible to do 'Sensor configuration' via Logic interface.
2. Do sensor(s) configuration in menu 'Setup / Sensor'.	

4.5.5 ZERO

ZERO allows for the compensation of the sensor offset voltage.
When ZERO is performed the current value at the sensor input is equated to pressure zero. In case of a 2 sensor system both sensor inputs will be adjusted. A max. offset voltage of +/-1.4V can be compensated. The offset value can be read via local and remote operation.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» for details)
Go to menu 'Zero / ZERO' and follow instructions.	1. Send OPEN VALVE
	2. Wait until process chamber is evacuated and sensor signal is not shifting anymore.
	3. Send ZERO

- Do not perform ZERO as long as pressure gauge voltage is shifting otherwise incorrect pressure reading is the result. Refer to manual of sensor manufacturer for warm up time.
- Do not perform ZERO, if the base pressure of your vacuum system is higher than 1‰ of sensor full scale. We recommend disabling ZERO function in this case; refer to «Valve and sensor configuration» of the setup procedure. Otherwise incorrect pressure reading is the result.

4.5.6 LEARN

LEARN adapts the PID controller of the valve to the vacuum system and its operating conditions. LEARN must be executed only once during system setup. The LEARN routine determines the characteristic of the vacuum system. Based on this, the PID controller is able to run fast and accurate pressure control cycles. This characteristic depends on various parameters such as chamber volume, conductance and flow regime. Therefore it must be performed with a specific gas flow according to instruction below.
The result of LEARN is a pressure versus valve position data table. This table is used to adapt the PID parameters. The data table is stored in the device memory which is power fail save. The data table can be up-/downloaded via 'Control Performance Analyzer' software or remote interface. Due to encoding the data may not be interpreted directly.
By an OPEN VALVE, CLOSE VALVE, POSITION CONTROL or PRESSURE CONTROL command the routine will be interrupted.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» for details)
Go to 'Learn / LEARN' menu and follow instructions. **Note:** Gasflow calculation according to recommendation below is done automatically based on inputs.	1. Set OPEN VALVE
	2. Set specific gas flow according to calculation below and wait until flow is stable. Autolearn does not need to be performed with the process gas. Instead N_2 or Ar may be used.
	3. Set SETPOINT (= pressure limit for learn) to p_{max} (max. pressure to control during process)
	4. Set LEARN **Note:** Alarm is set as long learn is performed, if alarm is off, learn is finished.
	5. Reset LEARN
	6. Reset OPEN VALVE

Sensor signal must not shift during LEARN. Wait until sensor signal is stable before LEARN is performed. Learn may take several minutes. Do not interrupt the routine as **a single full run is required to ensure fast and accurate pressure control**. The PID controller covers 5% to 5000% of the gas flow which was used for learn.

Gasflow calculation for LEARN:

Do not apply a different gasflow for learn than determined below. Otherwise pressure control performance may be insufficient. Required pressure / flow regime must be known to calculate the most suitable learn gas flow for a specific application.

Choose the applicable formula depending on units you are familiar with.

$$q_L = \frac{p_{SFS} \bullet C_{min}}{2000}$$

q_L gasflow for learn [**Pa m^3/s**]
p_{SFS} sensor full scale pressure [**Pa**]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

$$q_L = \frac{p_{SFS} \bullet C_{min}}{2}$$

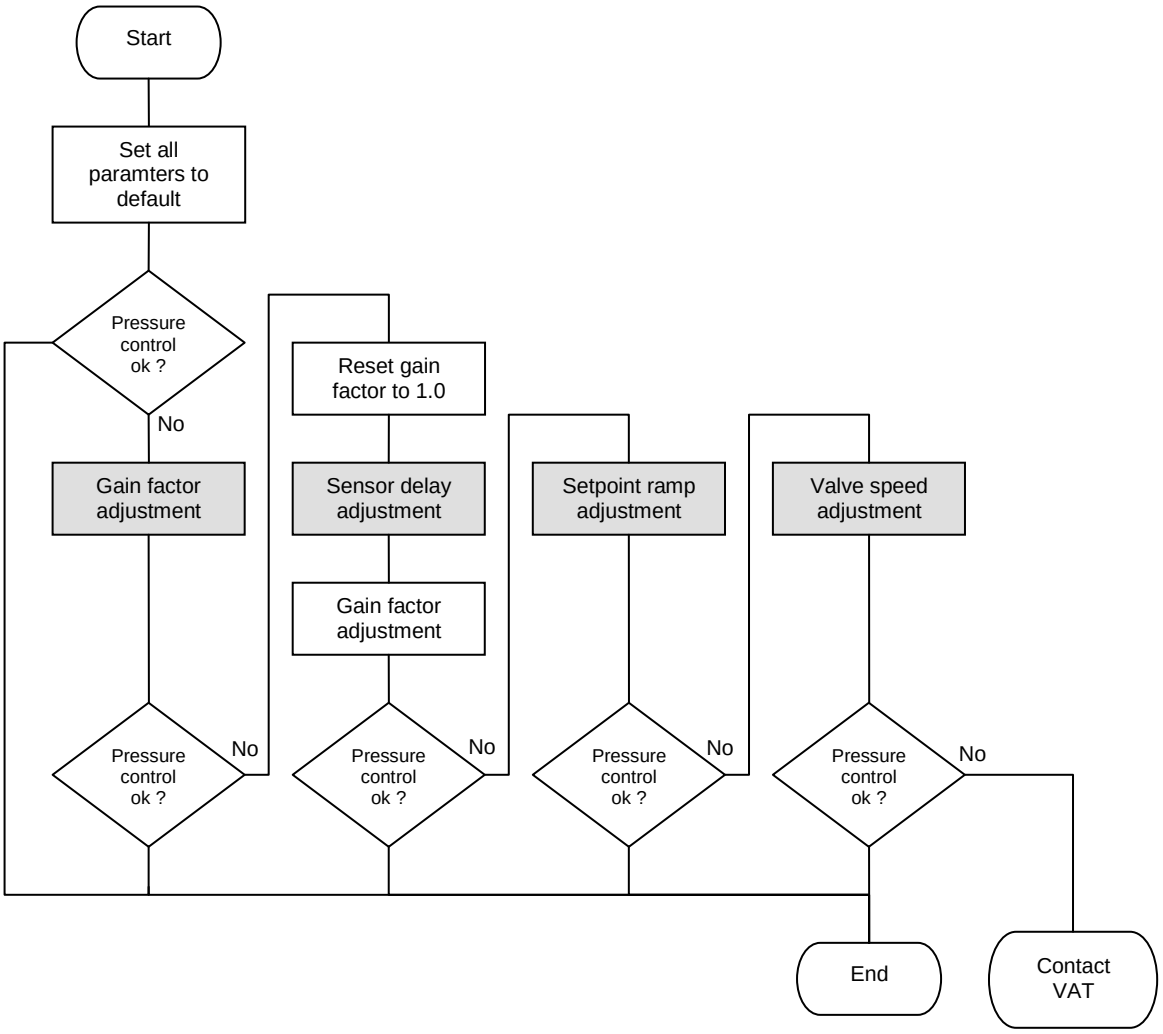
q_L gasflow for learn [**mbar l/s**]
p_{SFS} sensor full scale pressure [**mbar**]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

$$q_L = 39.4 \bullet p_{SFS} \bullet C_{min}$$

q_L gasflow for learn [**sccm**]
p_{SFS} sensor full scale pressure [**Torr**]
C_{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

4.5.7 Tuning of control performance

Normally the default settings will result in good pressure control performance. For some applications tuning may be required to improve performance. The tuning procedures for each parameter (grey boxes) and its default values are described separately below. Strictly keep the procedure order.



Required information for support:

- Go to ‘Tools / Create Diagnostic File’ in ‘Control View’ resp. ‘Control Performance Analyzer’ and save file
- Pressure / flow / gas conditions to be controlled
- Chamber volume
- Pumping speed (l/s) and pump type (e.g. turbo pump)
- System description
- Problem description

Send diagnostic file with and all required information to tuning-support@vat.ch

4.5.7.1 Gain factor adjustment

The gain factor effects: **Stability, Response time**

Default value is 1. Adjustment range is from 0.0001 to 7.5.

Higher gain results in:	faster response	higher over- / undershoot of pressure
Lower gain results in:	slower response	lower over- / undershoot of pressure

Adjustment procedure:

1. Start with gain factor 1.0
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with lower (higher) gain factors until optimal pressure response is achieved and stability is ok.

Normally adjustments down to gain factors of 0.42 should lead to good results. Otherwise you may need to improve sensor connection. Refer to «Requirements to sensor connection».

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘)	**Remote operation**:
Set gain factor in menu ‘Setup / Control Parameter’	It’s not possible to do ‘Gain factor adjustment‘ via remote operation.

4.5.7.2 Sensor delay adjustment

Sensor delay adjustment effects: **Stability**

Default value is 0sensorDeay0. Adjustment range is from 0 to 1.0s.

Pipes and orifices for sensor attachment delay response time and so badly impact pressure control stability.
By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.

Whenever possible sensors should be attached to the chamber according to «Requirements to sensor connection». This is the most effective measure against stability issues. If your gauge attachment fulfills these criteria do not use this parameter.

Adjustment procedure:

1. Start with gain factor 1.0 and sensor delay 0s.
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with higher sensor delays until best possible stability is achieved.
5. Adjustment gain factor again. Refer to «Gain factor adjustment».

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘)	**Remote operation**:
Go to ‘Setup / Control Parameter’ menu. Select sensor delay.	It’s not possible to do ‘Sensor delay adjustment‘ via remote operation.

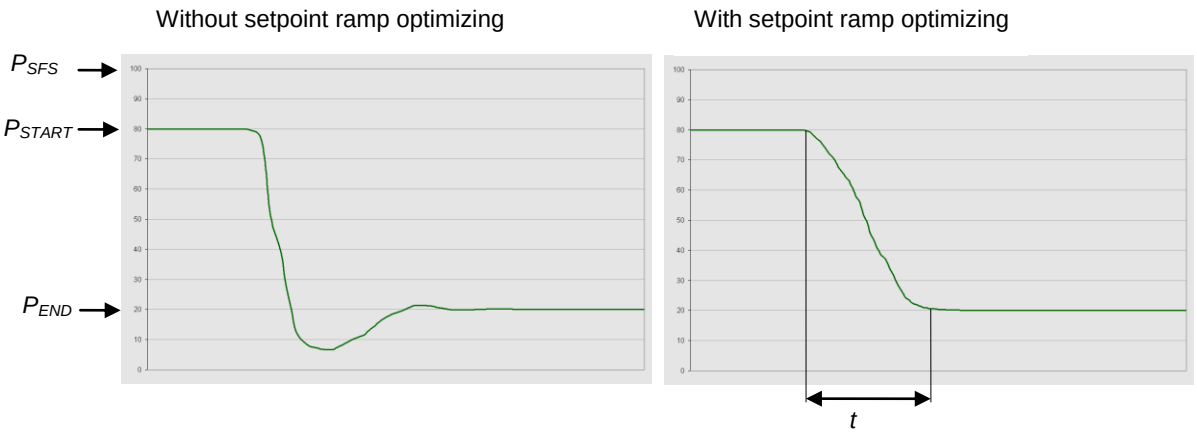
4.5.7.3 Setpoint ramp adjustment

Setpoint ramp effects: **Undershoot of pressure, Response time**

Default value for Setpoint Ramp is 1. Adjustment range for Setpoint Ramp is from 0 to 10 s.

This parameter defines the time that is used to decrease / raise pressure between 2 setpoints. Especially in pressure decrease situations at low flows pressure response can be improved much by adapting setpoint ramp time.

Pressure chart



Choose the applicable formula depending on units you are familiar with.

$$t = \frac{S_{RAMP}}{P_{SFS}} \bullet \left| P_{START} - P_{END} \right|$$

t	ramptime [**s**]
P_{SFS}	sensor full scale pressure
S_{RAMP}	setpoint ramp [**s**]
P_{START}	pressure start
P_{END}	pressure end

Adjustment procedure:

1. Start with optimal gain factor and sensor delay time according to preceding tuning steps.
2. Control a typical pressure / flow situation.
3. Control a lower pressure.
4. Repeat from step 2 with longer setpoint ramps until best response is achieved.
5. Verify pressure control response for a setpoint raise situation.

In case a long ramp time is required to get optimal performance for pressure decrease situations it may be of advantage to apply different settings for decrease / raise control situations.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘)	**Remote operation:**
Go to ‘Setup / Control Parameter’ menu. Select setpoint ramp.	It’s not possible to do ‘Setpoint ramp adjustment‘ via remote operation.

4.5.7.4 Valve speed adjustment

Valve speed effects: **Response time**

Default value is 1000. Adjustment range is from 1 to 1000.

This parameter effects valve plate actuating speed.
Speed adjustment is effective for PRESSURE CONTROL and POSITION CONTROL.

Normally best pressure control response is achieved with max. valve speed. In particular applications it may be of advantage to have a slower valve response. OPEN and CLOSE are always done with maximum speed.

Adjustment procedure:

1. Use optimal gain factor, sensor delay time and setpoint ramp according to preceding tuning steps.
2. Open valve.
3. Control a typical pressure / flow situation.
4. Repeat from step 2 with slower valve speed until required response is achieved.

Local operation: (‘Control View’, ‘Control Performance Analyzer’ or ‘Service Box 2‘)	**Remote operation**:
Go to ‘Setup / Control Parameter’ menu. Select valve speed.	It’s not possible to do ‘Valve speed adjustment‘ via remote operation.

5 Operation

	**⚠ WARNING** **Unqualified personnel** Inappropriate handling may cause serious injury or property damage. Only qualified personnel are allowed to carry out the described work.

	**⚠ WARNING** **Valve opening** Risk of serious injury. Human body parts must be kept out of the valve opening and away from moving parts. Do not connect the controller to power before the valve is installed complete into the system.

5.1 Normal operation

This valve is designed for downstream pressure control in vacuum chambers. It can be employed in a pressure control mode or a position control mode. In both cases local or remote operation is possible.

5.1.1 Local operation

Local operation means that the valve is operated via the service port using a computer or the Service Box 2. When using a computer, a service cable and a software from VAT are required. You can either download our freeware 'Control View' from www.vatvalve.comor purchase our 'Control Performance Analyzer'.

These softwares are beneficial especially for setup, testing and maintenance.

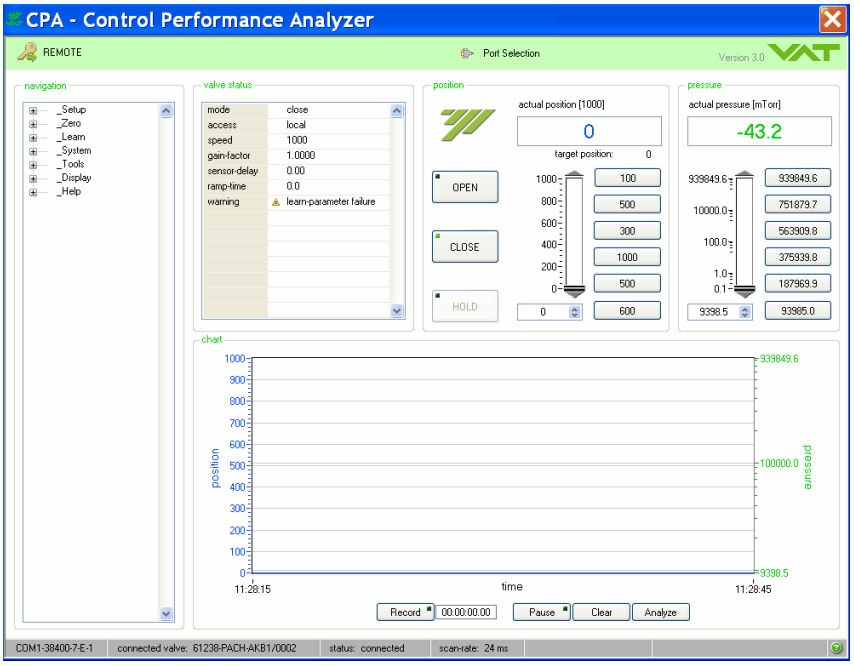
How to start:
Connect service cable, start software and push button ‘LOCAL’ to enable for operation. Then enter menu Setup/Sensor and do sensor configuration according to your application to make sure that you get the correct pressure displayed.

‘Control view’ supports:

- parameter setup
- manual control
- numeric monitoring
- basic diagnostic

'Control Performance Analyzer' supports:

- parameter setup
- manual control
- sequence control
- numeric and graphical monitoring
- data recording
- data analysis
- advanced diagnostic



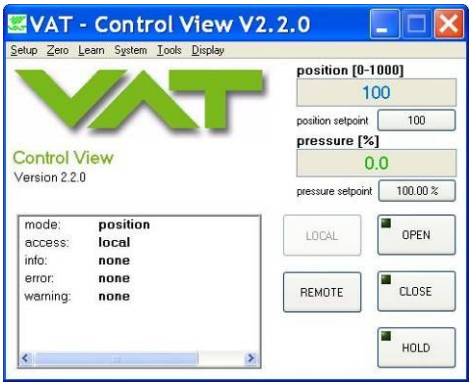
When communication to service port is interrupted the valve will change to remote operation. So when service cable will be disconnected or software will be shut down, the valve returns automatically to remote operation. This may result in an immediate movement of the valve depending on remote control.

Refer to «Accessories» for ordering numbers of service cable, software and Service Box 2.

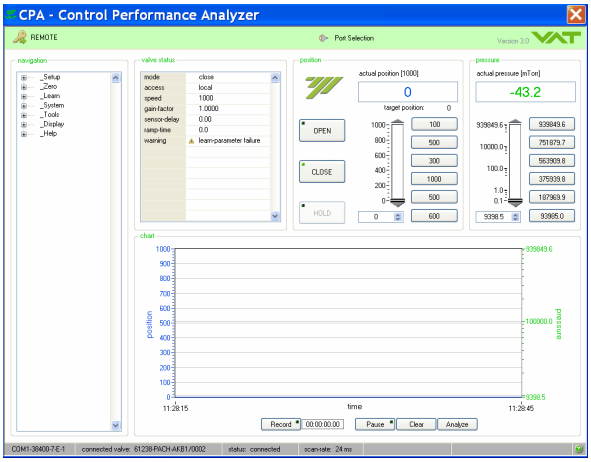
5.1.2 Remote operation

This product is equipped with a Logic interface to allow for remote operation. See section «Logic interface» for details. ‘Control View’ software, 'Control Performance Analyzer' software or 'Service Box 2' may be used for monitoring during remote control.

‘Control View’ software



'Control Performance Analyzer' software



'Service Box 2'

In case ‘Control View’ or ‘Control Performance Analyzer’ software is connected to valve make sure ‘REMOTE’ button is pushed to enable for remote operation. In case Service Box 2 is connected to valve make sure the LED on button ‘LOCAL’ is OFF for remote operation.

5.2 Close valve

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» for details)
Push CLOSE button	Send CLOSE VALVE

5.3 Open valve

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» for details)
Push OPEN button	Send OPEN VALVE

5.4 Position control

The valve position is directly controlled according to the position setpoint.

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» and «Analog inputs and outputs» for details)
Select or enter position setpoint	1. Set CONTROL MODE to POSITION CONTROL
	2. Set position SETPOINT

Note: In case CLOSE VALVE, OPEN VALVE or HOLD is also set these have higher priority.

5.5 Pressure control

To **prepare** valve **for PRESSURE CONTROL** perform complete **«Setup procedure»**.

The valve has parameters that may be modified to tune **pressure control performance**.
Refer to **«Tuning of control performance»**.

The included PID controller controls the chamber pressure according to the pressure setpoint by means of the valve position. The PID controller works with an adaptive algorithm to achieve best results under altering conditions (gasflow, gas type).

Local operation: ('Control View', 'Control Performance Analyzer' or 'Service Box 2')	**Remote operation**: (Refer to chapter «Digital inputs» and «Analog inputs and outputs» for details)
Select or enter pressure setpoint	1. Set CONTROL MODE to PRESSURE CONTROL
	2. Set pressure SETPOINT

Note: In case CLOSE VALVE, OPEN VALVE or HOLD is also set these have higher priority.

5.5.1 Operation with 2 sensors

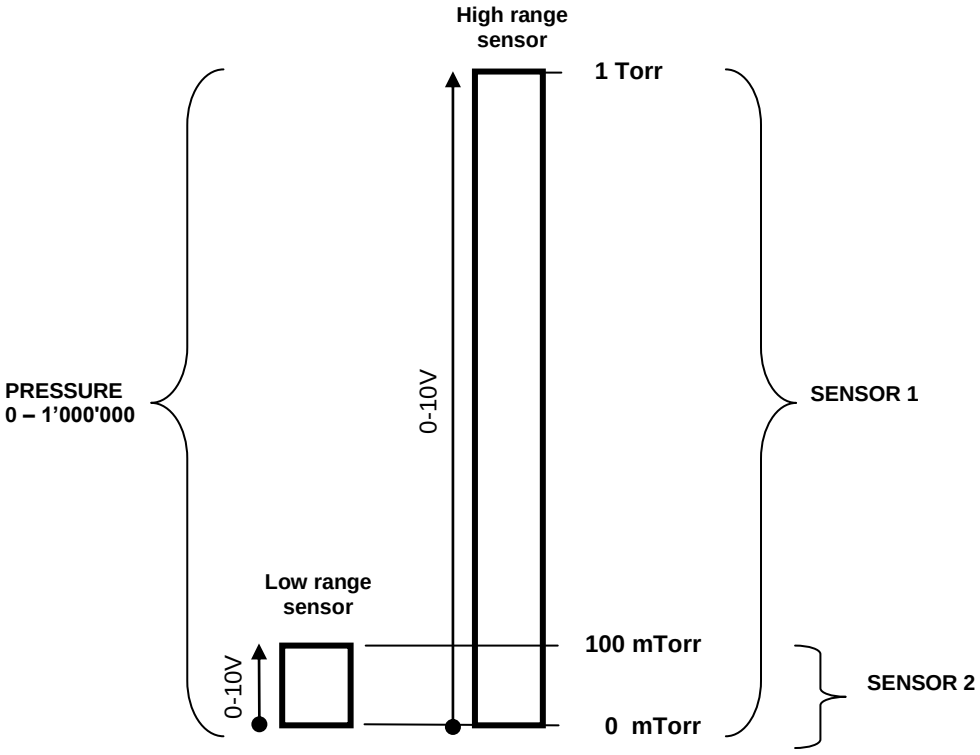
[applicable with 650 . . - . . . **E** - . . . . version only]

If 2 sensor operation is enabled, changeover between the sensors is done automatically during pressure control. For configuration refer to chapter «Setup procedure». We recommend a ratio of 10:1 between the pressure gauges. Max. ratio is 100:1. It is required that the high range pressure gauge is connected to sensor 1 input and the low range pressure gauge to the sensor 2 input.
Between 90 and 100% of the low range sensor full scale, the low range sensor is phased out while high range sensor is phased in. This maintains a functional response behavior in case of small calibration errors between the two sensors. The pressure output in this range is a blend between both sensors.
For monitoring purpose each sensor signal may be read out individually.

Note: Make sure that both sensors are calibrated.

Note: Do not close optional gauge isolation valves during the transition phase between the sensors.

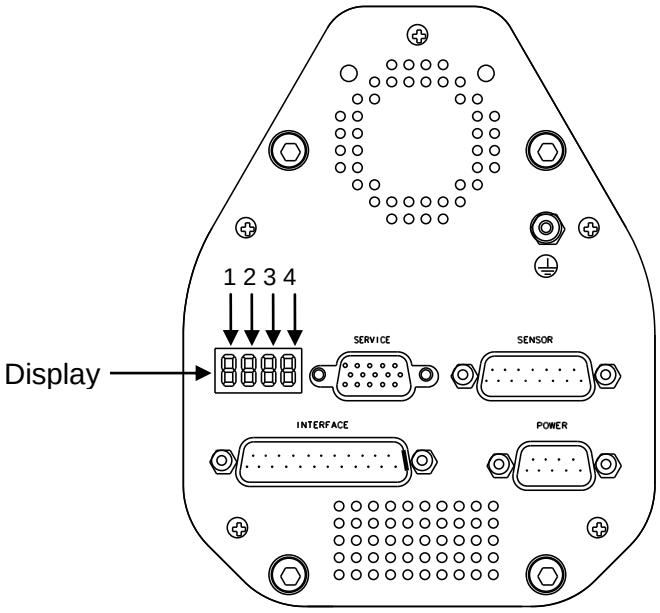
Example of PRESSURE and SENSOR READING allocation:



Above picture shows a 2 sensor system. In this configuration sensor 2 covers low range (100 mTorr) and sensor 1 covers high range (1 Torr).
Switchover between sensors is done automatically according to «Pressure control operation with 2 sensors».

5.6 Display information

There is a 4 digit display located on the panel. It displays configuration, status and position information. For details refer to following tables.



5.6.1 Power up

Description	Digit 1	Digit 2	Digit 3	Digit 4
At first all dots are illuminated then configuration is displayed: • Firmware version [e.g. 1E00] (1st information for about 2s) • Controller configuration (2nd information for about 2s) In case **D C** or **D999** is displayed, motor interlock is active. Refer to «Safety mode» for details. If valve is closed (isolated) display shows alternately **C C** and **INIT**. Synchronization will be done when first movement command is received.	**1**	**E**	**0**	**0**
		1 = Logic interface	**0** = basic **1** = with SPS[1)] **2** = with PFO[2)] **3** = with SPS[1)] and PFO[2)]	**1** = 1 sensor version **2** = 2 sensor version
SYNC indicates that synchronization is running.	**S**	**Y**	**N**	**C**

[1)] SPS = optional ±15 VDC Sensor Power Supply module [2)] PFO = optional Power Failure Option

5.6.2 Operation

Description / Mode	Digit 1	Digit 2	Digit 3	Digit 4
PRESSURE CONTROL mode	**P**	**0 . . . 100** = valve position (%, 0 = closed / 100 = open)		
POSITION CONTROL mode	**V**			
Valve closed	**C**			
Valve open	**O**			
HOLD (position frozen) activated	**H**			
ZERO running	**Z**			
LEARN running	**L**			
Safety mode established. Refer to «Safety mode» for details.	**D**			
Power failure	**F**			
Service request [1)]			**S**	**R**

[1)] If SR is blinking alternatively with the actual mode display (e.g. P.11 ⇔ ..SR) the valve requires cleaning.

5.6.3 Errors

Description	Digit 1	Digit 2	Digit 3	Digit 4
Compressed air failure (< 4 bar / 55 psi)	**A**	**I**	**R**	**f**
Compressed air on exhaust	**A**	**I**	**R**	**x**
Fatal error occurred	**E**	Error code. Refer to «Trouble shooting» for details		

5.6.4 Safety mode

By means of an external switch (see connection diagrams «Electrical connection») the motor power supply can be interrupted. In this case the valve enters the ‘safety mode’. This motor interlock prevents the valve from moving (e.g. maintenance work). Data reading from the control unit remains possible. When motor interlock is active during power up the valve directly enters the ‘safety mode’ and is not able to synchronize. Display shows ‘D C’ or ‘D999’. In this case synchronization cycle will be done when motor interlock is deactivated. Then Display shows ‘INIT’ for a moment followed by ‘SYNC’.
When ‘safety mode’ is entered from operation (i.e. pressure control mode), the unit will automatically switch to position control mode and remain at current position. Once motor interlock is deactivated the unit remains in position control mode.

5.6.5 Service indication

This product is able to indicate that the valve unit needs to be cleaned, or an obstruction is present.
A service request is indicated when the control unit detects that motor steps are apparently not effective. This may happen when the valve unit is heavily contaminated. These ‚lost‘ steps are recognized and will be repeated to attempt target position in the short term. But in the medium term the valve unit requires cleaning or inspection.
‘Service request’ (SR) would be indicated on the display or could be read via remote operation. Refer to «Display information» for details.

5.7 Operation during power up

Valve position before power up:	Reaction of valve:	
	Valve power up configuration = closed (default)	Valve power up configuration = open
Closed (isolated)	Valve remains closed. Display shows alternately 'C C' and 'INIT'. Synchronization will be done when first movement command is received.	Valve runs to max. throttle position to detect the limit stops to synchronize. Display shows configuration of product resp. 'SYNC' until synchronization is done. Valve position after power up is open.
All other than closed (not isolated)	Valve runs to max. throttle position to detect limit stop for synchronization. Display shows configuration of product resp. 'SYNC' until synchronization is done.	
	Valve position after power up is closed	Valve position after power up is open

Refer also to chapter: «Display information».

5.8 Behavior in case of power failure

Valve position before power failure:	Reaction of valve:	
	Without Power Failure Option (PFO) 650 . . - . . **G** . - . . . . 650 . . - . . **A** . - . . . . 650 . . - . . **T** . - . . . . 650 . . - . . **V** . -	With Power Failure Option (PFO) 650 . . - . . **H** . - . . . . 650 . . - . . **C** . - . . . . 650 . . - . . **U** . - . . . . 650 . . - . . **W**. - . . . .
Closed (isolated)	Valve remains closed.	Valve will close or open depending on valve configuration 1). Default is not defined. Display indicates **F**.
Valve open or in any intermediate position	Sealing ring moves down and blocks the pendulum plate at the current position.	

1) Provided that battery pack of the VAT controller is charged. Charging time after power up is 2 minutes max..

All parameters are stored in a power fail save memory.

5.9 Operation under increased temperature

⚠ CAUTION

Hot valve

Heated valve may result in minor or moderate injury.

Do not touch valve and heating device during operation. Once heating is switched off (valve and system) await until the valve is cooled down complete before doing any work.

This valve may be operated in the temperature range mentioned in chapter «Technical data».

5.10 Behavior In case of compressed air pressure drop

Valve position before pressure drop:	Reaction of valve:
Valve closed	Valve remains closed.
Valve open or in any intermediate position	Sealing ring moves down and blocks the pendulum plate at the current position. VAT controller with display indicates ‚COMPRESSED AIR FAILURE'. Refer to the manual of the VAT controller for details.

6 Trouble shooting

Failure	Check	Action
No dots lighted on display	- 24 V power supply ok?	- Connect valve to power supply according to «Electrical connection» and make sure that power supply is working.
Remote operation does not work	- Local operation via service port active	- Switch to remote operation.
	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
Display shows «**E 20**» (**fatal error** - limit stop of valve unit not detected)		- Reset control unit. Cycle power (OFF→ON) or - Send reset command: - local via service port with CV/CPA/Service Box2 - If reset unsuccessful, replace actuator according to «Maintenance procedures».
Display shows «**E 22**» (**fatal error** - rotation angle of valve plate limited during operation)	- Valve plate mechanically obstructed?	- Resolve obstruction. - Reset control unit. Cycle power (OFF→ON) or - Send reset command: - local via service port with CV/CPA/Service Box2
Display shows «**E 40**» (**fatal error** - motor driver failure detected)		- Replace control unit according to «Maintenance procedures».
Display shows «**D C**» or «**D999**» Motor Interlock is open	- Motor power supplied?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
Display shows «**SR**» (Service Request)	- Valve unit heavy contaminated or gate seal heavyly sticking?	- Clean valve and/or replace gate seal according to «Maintenance procedures».
CLOSE VALVE does not work	- Safety mode active, check for D on display? - Maintenance mode active	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details. - Refer to “Display shows «**M C**»” in this table
OPEN VALVE does not work	- Safety mode active, check for D on display? - Maintenance mode active	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details. - Refer to “Display shows «**M100**»” in this table
Display shows «**M C**» Maintenance mode active		- Pin 14 of service connector is connected to ground. Plate will close. Further movement of plate is blocked. Priority of pin 14 is higher than pin 13. If pin 14 is connected to ground after pin 13 the valve will close. Ground of service connector is at pin 4 and 8.
Display shows «**M100**» Maintenance mode active		- Pin 13 of service connector is connected to ground. Plate will open. Further movement of plate is blocked.
POSITION CONTROL does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
	- POSITION CONTROL selected, check for V on display?	- Select POSITION CONTROL mode. Refer to «Position control» for details.
COMPRESSED AIR FAILURE «**AIRf**»	- No or too less air pressure on air input of valve	- Connect air or increase air pressure. Make sure that the air pressure is more than 4 bar (55 psi).
COMPRESSED AIR FAILURE at Exhaust «**AIRx**»	- Wrong connection of compressed air input and output - No compressed air at output exhaust	- Connect compressed air in accordance chapter installation. - Contact your local VAT service center for support.

Failure	Check	Action
Pressure reading is wrong or pressure reading is negative	- Sensor(s) connected?	- Refer to «Electrical connection».
	- 2 sensor version present at valve controller?	- Check valve version on page 1. Verify configuration. Refer to «Setup procedure».
	- ZERO done?	- Perform ZERO when base pressure is reached. Refer to «ZERO» for details.
	- Does sensor power supply provide enough power for sensor(s)?	- Verify sensor supply voltage.
ZERO does not work	- Valve in open position, check for O on display?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- ZERO disabled?	- Enable ZERO. Refer to «Valve and sensor configuration» for details.
Pressure is not '0' after ZERO	- Sensor voltage shifting?	- Wait until sensor does not shift any more before performing ZERO.
	- System pumped to base pressure?	- OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- Sensor offset voltage exceeds ±1.4V	- Replace pressure gauge.
PRESSURE CONTROL does not work	- Safety mode active, check for D on display?	- Provide power to motor to allow for operation. - Refer to «Electrical connection» for details.
	- PRESSURE CONTROL selected, check for P on display?	- Select PRESSURE CONTROL mode. Refer to «Pressure control» for details.
	- LEARN done?	- Perform LEARN. Refer to «Setup procedure» for details.
PRESSURE CONTROL not optimal	- Setup done completely?	- Perform «Setup procedure» completely.
	- LEARN done?	- Perform LEARN. Refer to «LEARN» for details.
	- ZERO performed before LEARN?	- Perform ZERO then repeat LEARN. Refer to «Setup procedure» for details.
	- LEARN interrupted?	- Repeat LEARN. Refer to «LEARN» for details.
	- Was gas flow stable during LEARN?	- Repeat LEARN with stable gas flow. Refer to «LEARN» for details.
	- Tuning done?	- Tune valve for application. - Refer to «Tuning of control performance» for details.
	- Is sensor range suited for application?	- Use a sensor with suitable range (controlled pressure should be >3% and < 98% of sensor full scale).
	- Noise on sensor signal?	- Make sure a shielded sensor cable is used.

If you need any further information, please contact one of our service centers. You will find the addresses on our website: www.vatvalve.com.

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7 Maintenance

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

⚠ WARNING

Valve opening

Risk of serious injury.

Human body parts must be kept out of the valve opening and away from moving parts. Disconnect power on controller before doing any work.

⚠ CAUTION

Hot valve

Heated valve may result in minor or moderate injury.

Do not touch valve and heating device during operation. Once heating is switched off (valve and system) await until the valve is cooled down complete before doing any work.

NOTICE

Contamination

Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

7.1 Maintenance intervals

Under clean operating conditions, the valve does not require any maintenance during the specified cycle life. Contamination from the process may influence the function and requires more frequent maintenance.

Before carrying out any maintenance, please contact VAT. It has to be individually decided whether the maintenance can be performed by the customer or has to be carried out by VAT. Please write down the fabrication number of the valve before contact VAT. Refer to chapter «Identification of product» for fabrication number.

7.2 Maintenance procedures

Two maintenance procedures are defined for this valve. These are:

- **Replacement of isolation seals** (gate and body seal of sealing ring) **and valve cleaning**
- **Replacement of actuator shaft seals**

Required frequency of cleaning and replacement of seals is depending on process conditions.

VAT can give the following recommendations for preventive maintenance:

Replacement of	unheated [1)]	heated ≤ 80 °C [1)]	heated > 80 °C [1)]
isolation seals (gate and body seal of sealing ring)	200'000 cycles	6 months but max. 200'000 cycles	3 months but max. 200'000 cycles
actuator shaft seals	1'000'000 cycles	6 months	3 months

NOTICE

Vacuum grease

Vacuum grease may be distributed and contaminate the valve.

Prevent gap between body and sealing ring from air gun cleaning. Do not clean the gap between body and sealing ring with compressed air.

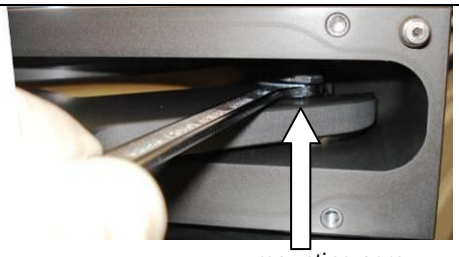
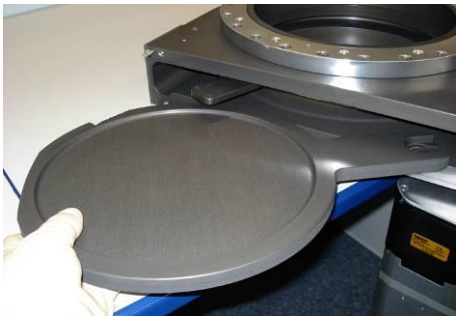
See figure below:

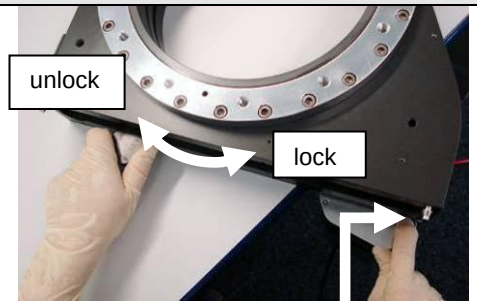
7.2.1 Replacement of isolation seals and cleaning

7.2.1.1 Required tools

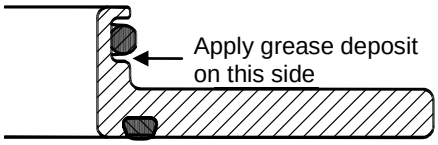
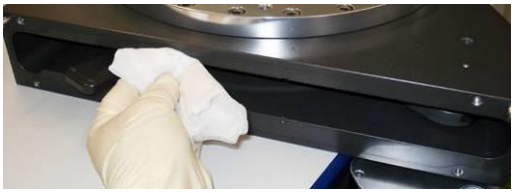
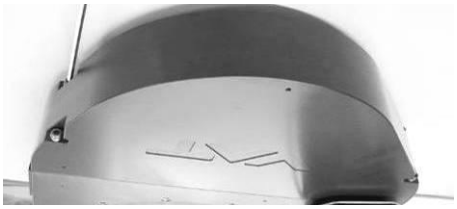
- Allen Wrench 5 mm
- Open end wrench 13 mm
- O-ring removal tool (see chapter: Accessories)
- VAT cleaning tool (see chapter: Accessories)
- Vacuum grease (see chapter: Spare parts)
- Clean room wiper
- Isopropyl alcohol

Electrical power and compressed air is required to perform steps 2 to 9 during disassembly respectively 9 to 2 during assembly.

Description		Required tool
1. Vent both valve chambers. 2. Open the 4 bonnet screws and remove valve bonnet.		Allen wrench 5 mm
3. Open the valve **Caution:** Pay attention plate moves out! 4. Unfasten mounting screw for pendulum plate. (For reinstall the pendulum plate, tighten the mounting screw to block.) 5. Remove pendulum plate.	 mounting screw for pendulum plate 	Open end wrench 13 mm

<table>
<tr><th colspan="3">Description</th><th>Required tool</th></tr>
<tr><td colspan="2">6. With one hand press the [Maintenance button] to lower the sealing ring, with your second hand unlock the sealing ring by pressing the handle.
7. Release [Maintenance button].
8. Remove sealing ring.
9. To prevent the shaft and retaining pins from moving during work, switch the valve to safety mode. Refer to «Safety mode» for details.
Retaining pins will move up.</td><td> 

Maintenance button</td><td></td></tr>
<tr><td colspan="2" rowspan="2">10. Remove gate and body seal from sealing ring carefully with a soft tool.
11. Remove grease residues at sealing ring with lint-and dust-free towel a little soaked with isopropyl alcohol.
Clean sealing ring and pendulum plate with lint-and dust-free cloth little soaked with isopropyl alcohol or in an ultrasonic bath.
12. Clean out valve body with alcohol. Use VAT cleaning tool or an appropriate non metal tool with a cloth to enter valve body.
Do not enter valve body with hands!
13. Clean or replace gate seal if necessary.
Install gate seal to sealing ring without grease.</td><td> 
gate seal</td><td rowspan="2">• O-ring removal tool
• VAT cleaning tool
• Isopropyl alcohol
• Clean room wiper</td></tr>
<tr><td> 
body seal</td></tr>
<tr><td colspan="2" rowspan="5">14. Clean or replace body seal if necessary.
Lubricate body seal with the quantity of vacuum grease listed in the table to the right.</td><td><table><tr><td>Valve size</td><td>Quantity of grease [ml]</td></tr><tr><td>DN 100</td><td>0.1</td></tr><tr><td>DN 160</td><td>0.15</td></tr><tr><td>DN 200</td><td>0.2</td></tr><tr><td>DN 250</td><td>0.2</td></tr></table></td><td rowspan="5">• O-ring removal tool
• Vacuum grease</td></tr>
<tr><td colspan="2">15. Install body seal into sealing ring.</td><td></td></tr>
<tr><td colspan="2" rowspan="5">16. Deposit vacuum grease on the bottom side of the body seal according to drawing below. Pay attention that the quantity of vacuum grease listed in the table to the right is distributed constantly over the whole circumference.</td><td><table><tr><td>Valve size</td><td>Quantity of grease [ml]</td></tr><tr><td>DN 100</td><td>0.2</td></tr><tr><td>DN 160</td><td>0.25</td></tr><tr><td>DN 200</td><td>0.3</td></tr><tr><td>DN 250</td><td>0.4</td></tr></table></td><td rowspan="5">Vacuum grease</td></tr>
</table>

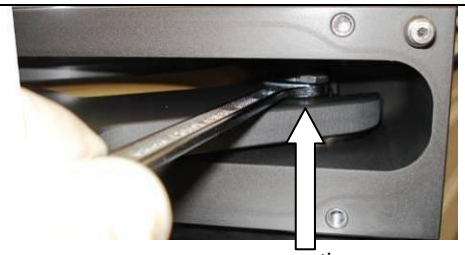
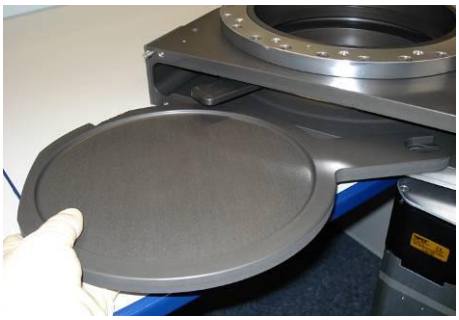
Description		Required tool
		Vacuum grease
17. Clean the valve body.		• VAT cleaning tool • Isopropyl alcohol
18. Reassembly the valve in reverse order, step 9…3.		
19. Clean the valve sealing surface.		• Isopropyl alcohol • Clean room wiper
20. Clean the bonnet.		• VAT cleaning tool • Isopropyl alcohol
21. Clean the valve bonnet o-ring. If necessary, replace the bonnet o-ring.		Clean room wiper
22. Close the valve bonnet. Tightening the bonnet screws with 6Nm.		Allen wrench 5mm

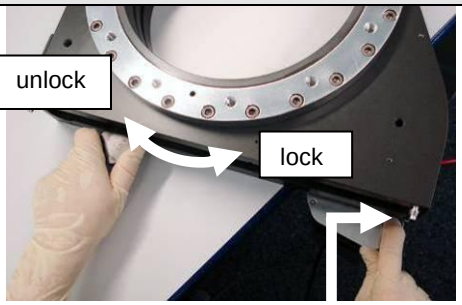
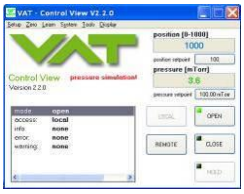
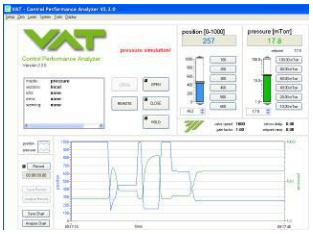
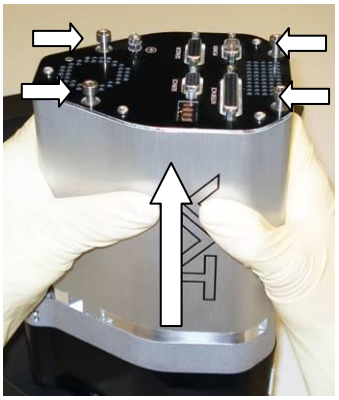
7.2.2 Replacement of actuator shaft seals

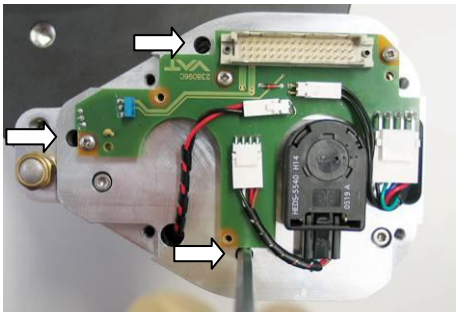
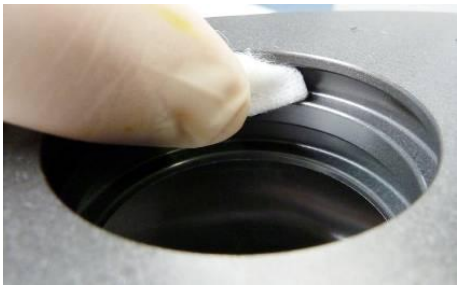
7.2.2.1 Required tools

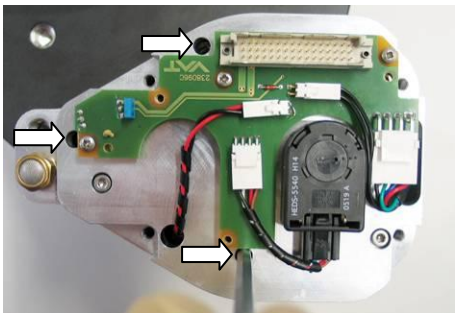
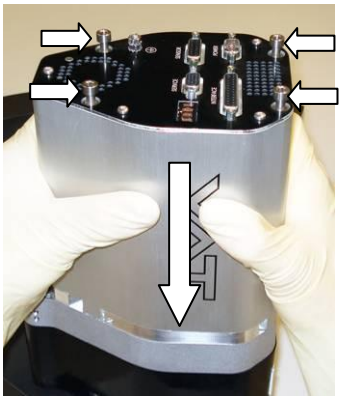
- Allen Wrench 2 mm
- Allen Wrench 4 mm
- Allen Wrench 5 mm
- Open end wrench 13 mm
- O-ring removal tool (see chapter: Accessories)
- VAT cleaning tool (see chapter: Accessories)
- Vacuum grease (see chapter: Spare parts)
- Clean room wiper
- Isopropyl alcohol

Electrical power and compressed air is required to perform steps 2 to 9 during disassembly respectively 9 to 2 during assembly.

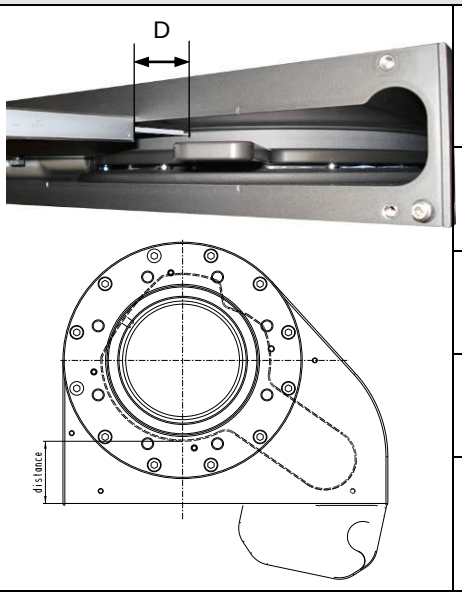
Description		Required tool
1. Vent both valve chambers. 2. Open the 4 bonnet screws and remove valve bonnet.		Allen wrench 5 mm
3. Open the valve **Caution:** Pay attention plate moves out! 4. Unfasten mounting screw for pendulum plate. (For reinstall the pendulum plate, tighten the mounting screw to block.) 5. Remove pendulum plate.	 mounting screw for pendulum plate 	Open end wrench 13 mm

Description		Required tool
6. With one hand press the [Maintenance button] to lower the sealing ring, with your second hand unlock the sealing ring by pressing the handle. 7. Release [Maintenance button]. 8. Remove sealing ring. 9. To prevent the shaft and retaining pins from moving during work, switch the valve to safety mode. Refer to «Safety mode» for details. Retaining pins will move up.	 Maintenance button	
10. Release the valve from safety mode. Refer to «Safety mode» for details 11. Move the valve to position 50% (half opened) This is necessary, in order to dismount the actuator. See steps 19 to 21. 12. Disable PFO option feature via 'Power Fail Status' in menu 'System' of CV or CPA software, and turn off the power	  	• CV software • CPA software or • Service box 2
13. Disconnect 24VDC power. Wait for 60s, then disconnect cables and compressed air from valve actuator. 14. Unfasten all 4 controller screws and lift the controller carefully from actuator.		Allen wrench 4 mm

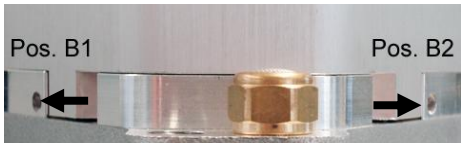
Description		Required tool
15. Unfasten all 3 actuator screws and remove actuator.		Allen wrench 5 mm
16. Remove actuator shaft seals carefully with soft tool.		O-ring removal tool
17. Clean the actuator feed through and grooves.		• Clean room wiper • Isopropyl alcohol
18. Lubricate each o-ring groove with 0.1 ml vacuum grease. Pay attention that grease is distributed constantly over the whole circumference.		Vacuum grease
19. Clean or replace seals if necessary. 20. Lubricate each o-ring with 0.05 ml vacuum grease. 21. Install o-rings. 22. Deposit 0.1 ml vacuum grease on each o-ring. Pay attention that grease is distributed constantly over the whole circumference.		Vacuum grease

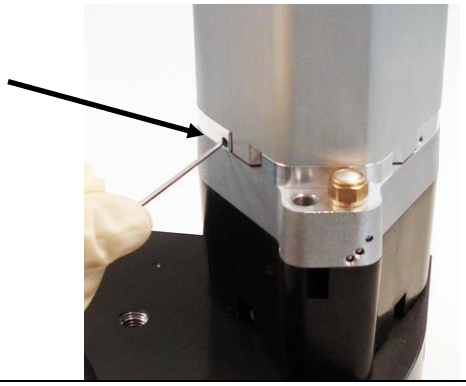
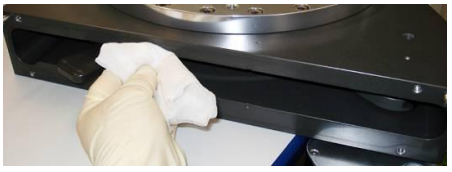
Description		Required tool
23. Remove fixation kit and mounting screw for pendulum plate. 24. Clean screw and slightly lubricate thread. Then reinstall fixation kit. 25. Clean actuator shaft and lubricate it with 0.1 ml vacuum grease.		Vacuum grease
26. Install actuator • Tighten actuator screws with 6 Nm. • Remove vacuum grease from actuator shaft face after installation.		Allen wrench 5 mm
27. Install controller • Tighten the controller screws with 3 Nm. • Connect cables at controller • Connect compressed air at actuator		Allen wrench 4 mm
28. Turn on power of controller. **Caution:** Valve moves to close position 29. Open valve and install sealing ring and pendulum plate in reverse order as they had been disassembled (steps 9 to 3).		Open end wrench 13 mm

<table>
<tr><th colspan="3">Description</th><th>Required tool</th></tr>
<tr><td rowspan="5">If actuator was replaced, proceed with step 30, otherwise go to step 34.

30. Close valve and check if pendulum plate is in center of flange. Check can be done either visual or by measurement.
When the valve is mounted to a tool, the bonnet has to be removed and the center position can be measured by a depth gauge (see picture).
If the centering (or distance D) is not correct, proceed with step 31.</td><td rowspan="5"> 

</td><td>DN</td><td>Distance D [mm] between bonnet flange surface and pendulum plate.</td></tr>
<tr><td>100</td><td>51.5 ±0.5</td></tr>
<tr><td>160</td><td>45.0 ±0.5</td></tr>
<tr><td>200</td><td>40.0 ±0.5</td></tr>
<tr><td>250</td><td>50.0 ±0.5</td></tr>
<tr><td>31. If necessary adjust pendulum plate:

a. Move pendulum plate a little towards open (e.g. position 1% of full stroke)
b. Use adjustment screw at flange side of actuator (1 turn clockwise adjusts pendulum plate by about 3mm towards open).
c. Restart valve in menu ‘System/Recovery’
d. Check pendulum plate position according step 37 and redo adjustment procedure if necessary.</td><td colspan="2">Adjusting screw mounted either in actuator position «B1 standard» or «B2 option»
 

 </td><td>Allen wrench 2 mm</td></tr>
<tr><td>32. Clean the valve sealing surface</td><td colspan="2">  </td><td>• Clean room wiper
• Isopropyl alcohol</td></tr>
<tr><td>33. Clean the valve bonnet o-ring</td><td colspan="2">  </td><td>Clean room wiper</td></tr>
<tr><td>34. Mount valve bonnet.
• Tightening torques for bonnet screws, see in table to the right.</td><td colspan="2">Max. torque 6 Nm</td><td>Allen wrench 5 mm</td></tr>
</table>

7.2.3 Replacement of Option board

NOTICE

Electrostatic discharge

Electronic components could be damage.

All work on the control and actuating unit has to be done under ESD protected environment to prevent electronic components from damage.

NOTICE

Burned connector pins (spark)

Connector pins or electronic parts could damage, if plugged and unplugged under power.

Do not plug or unplug connectors under power.

The option board may or may not be equipped in your valve depending on the order. Refer to page 1 of this manual to check valve version. This board includes the optional modules for the valve which are:

- ±15 VDC sensor power supply (SPS)
- Power failure option (PFO)

It is available in 3 versions. These are:

- SPS module only
- PFO module only
- SPS and PFO module

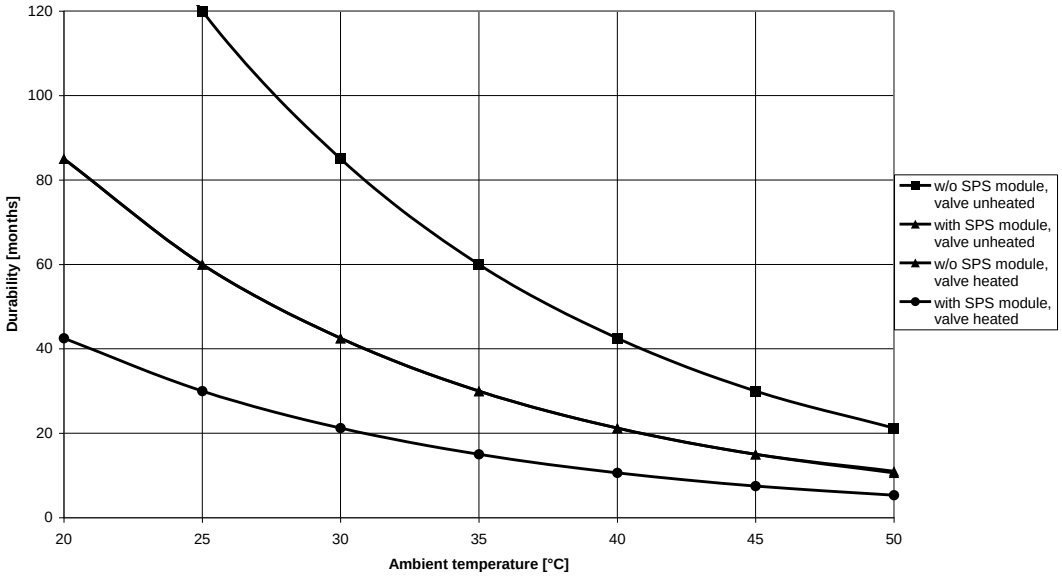
The modules may be retrofitted or replaced easily. The battery lifetime of the PFO module depends on the ambient temperature (see below). To assure PFO function the option board must be replaced after battery life has expired. For ordering number of the modules refer to chapter «Spare parts».

7.2.3.1 Durability of power fail battery

The curves in the graph show the estimated life of Ultra Cap PFO in the worst condition (max. sensor load = 1 A, valve heating temperature = 150 °C).

If the SPS is not fully loaded (< 1 A) or heating temperature of valve body is lower than 150 °C, the corresponding life time curve will be somewhere in between the upper and the lower curve.

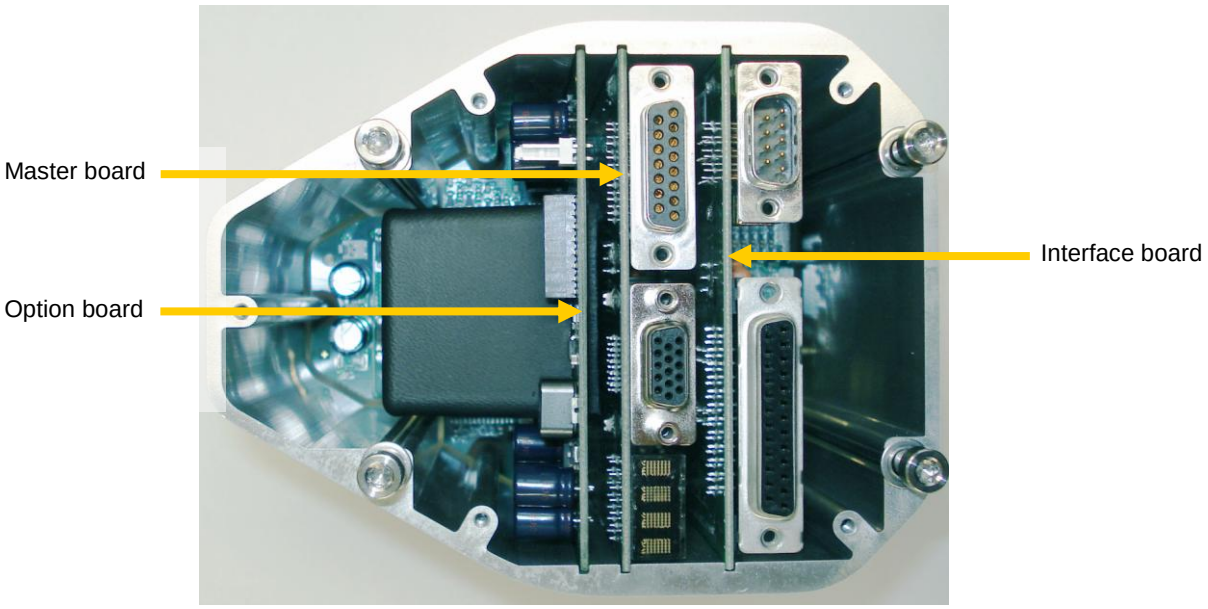
Therefore please determine the equivalent maintenance period for replacing the Ultra Cap battery (Option board).



This graph shows estimated life of Ultra Cap PFO for reference and not as guaranteed value.

7.2.4 Retrofit / replacement procedure

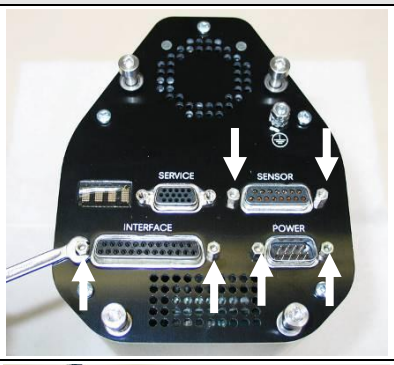
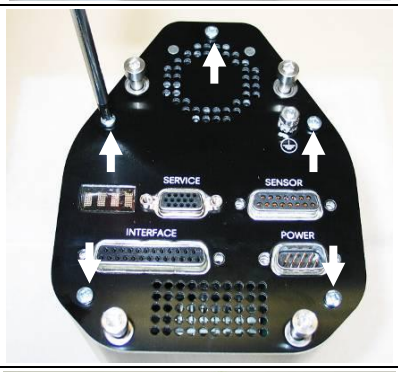
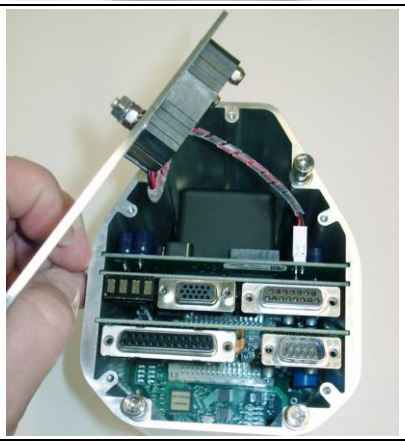
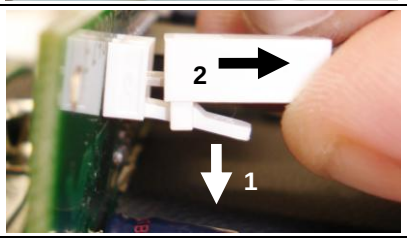
Top view on control and actuating unit with panel removed:

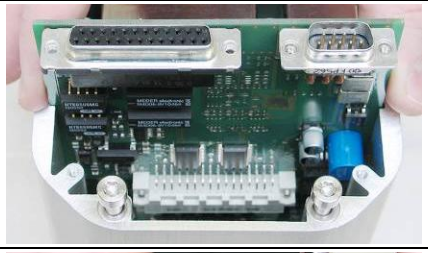
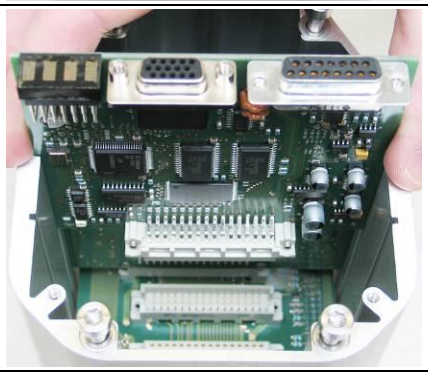
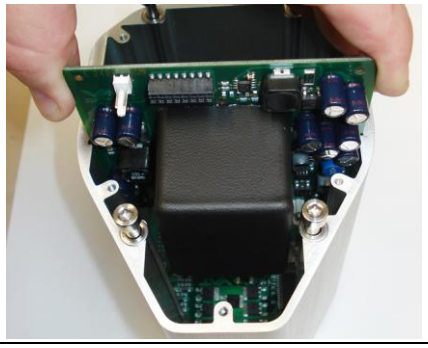


All boards have a fixed position into control and actuating unit. It is not possible to fit a board in other position as shown in picture above! Do not try out other positions, which maybe destroy the socket of boards!

7.2.4.1 Required tools

- Pozidriv screw driver size 1
- Open end wrench 4.5mm

Description		Required tool
1. Remove female screw locks from POWER, SENSOR and INTERFACE connectors.		Open end wrench 4.5 mm
2. Remove the panel screws.		Pozidriv screw driver size 1
3. Lift the panel carefully.		
4. Pull out the option board a little. 5. Push the connector release (1) a little down and disconnect fan cable (2) from option board.		

Description		Required tool
6. Remove or replace interface board.		
7. Remove or replace master board.		
8. Remove or replace option board.		
9. Insert master board and interface board in reverse order as disassembled at correct positions (see steps 7 to 6).		
10. Reconnect fan cable to option board (see steps 5 to 4).		
11. Place the panel and tighten panel screws with 1.1 Nm (see steps 3 to 2).		Pozidriv screw driver size 1
12. Tighten female screw locks from POWER, SENSOR and INTERFACE connectors with 1.1 Nm (see step 1).		Open end wrench 4.5 mm

If you need any further information, please contact one of our service centers. You can find the addresses on our website: www.vatvalve.com.

8 Repairs

Repairs may only be carried out by the VAT service staff. In exceptional cases, the customer is allowed to carry out the repairs, but only with the prior consent of VAT.

Please contact one of our service centers. You will find the addresses on our website www.vatvalve.com.

9 Dismounting and Storage

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

9.1 Dismounting

NOTICE

Contamination

Gate and other parts of the valve must be protected from contamination.

Always wear clean room gloves when handling the valve.

NOTICE

Valve in open position

Valve body may become damaged if valve gate is in open position.

Move valve gate to the closed position before dismounting the valve.

1. Close the valve

2. For dismounting the valve please follow the instructions of chapter: «Installation», however in reverse order.

9.2 Storage

NOTICE

Wrong storage

Inappropriate temperatures and humidity may cause damage to the product.

Valve must be stored at:
– relative humidity between 10% and 70%
– temperature between +10 °C and +50 °C
– non-condensing environment

NOTICE

Inappropriate packaging

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

1. Clean / decontaminate valve.
2. Cover all valve openings with a protective foil.
3. Pack valve appropriately, by using the original packaging material.

10 Packaging and Transport

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

⚠ WARNING

Harmful substances

Risk of injury in case of contact with harmful substances.

Remove harmful substances (e. g. toxic, caustic or microbiological ones) from valve before you return the valve to VAT.

NOTICE

Inappropriate packaging

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

- When returning products to VAT, please fill out the VAT form «Declaration of Chemical Contamination of Vacuum Valves and Components» and send it to VAT in advance. The form can be downloaded from our website www.vatvalve.com (Section: Services – Aftersales).
- If products are radioactively contaminated, the VAT form «Contamination and Radiation Report» must be filled out. Please contact VAT in advance.
- If products are sent to VAT in contaminated condition, VAT will carry out the decontaminating procedure at the customer's expense.

10.1 Packaging

NOTICE

Valve in open position

Valve mechanism may get damaged if valve is in open position.

Make sure that the valve is closed.

1. Cover all valve openings with a protective foil.
2. Pack valve appropriately, by using the original packaging material.

VAT disclaims any liability for damages resulting from inappropriate packaging.

10.2 Transport

NOTICE

Inappropriate packaging

Product may get damaged if inappropriate packaging material is used.

Always use the original packaging material and handle product with care.

VAT disclaims any liability for damages resulting from inappropriate packaging.

11 Disposal

⚠ WARNING

Unqualified personnel

Inappropriate handling may cause serious injury or property damage.

Only qualified personnel are allowed to carry out the described work.

12 Spare parts

NOTICE

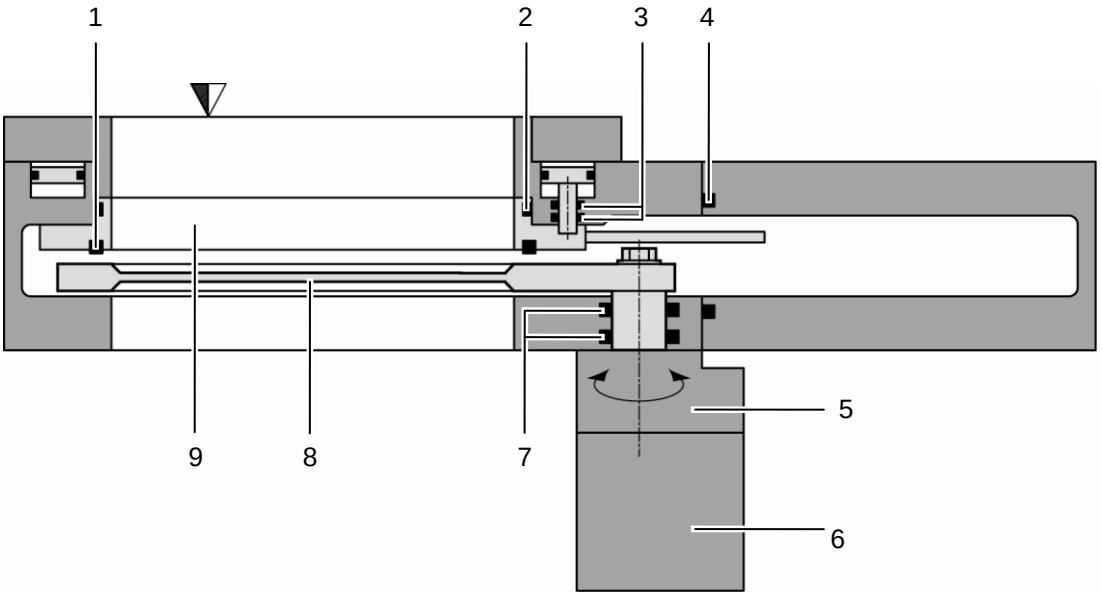
Non-original spare parts

Non-original spare parts may cause damage to the product.

Use original spare parts from VAT only.

- Please specify the fabrication number of the product when you place an order for spare parts; see chapter: «Identification of product». This is to ensure that the appropriate spare parts are supplied.
- VAT makes a difference between spare parts that may be replaced by the customer and those that need to be replaced by the VAT service staff.
- The following table(s) contain spare parts that may be replaced by the customer. If you need any other spare parts, please contact one of our service centers. You will find the addresses on our website www.vatvalve.com.

12.1 Drawing



1	Plate seal	6	Integrated controller
2	Body seal	7	Rotary feedthrough seals
3	Shaft feedthroug seals	8	Pendulum plate
4	Bonnet seal	9	Sealing ring
5	Actuator		

All “Item“ refer to chapter «Drawing»

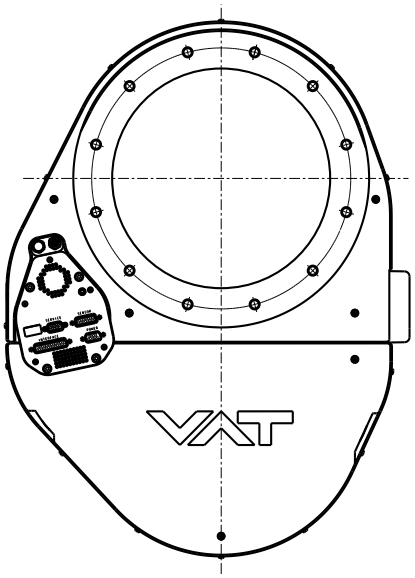
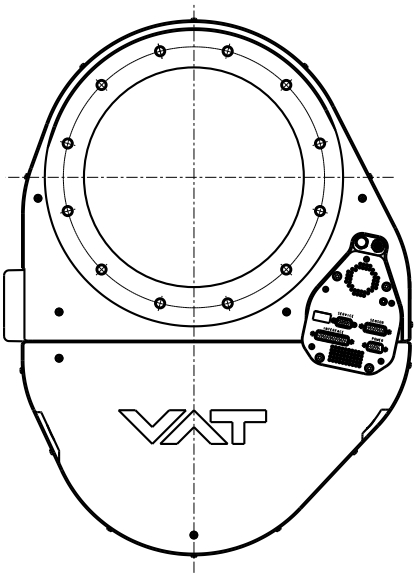
12.1.1 Valve unit with seals and grease

Item	Description					
	Valve size **Valve part number**		**DN100** **65040 - . . . . - . . . .**	**DN160** **65044 - . . . . - . . . .**	**DN200** **65046- . . . . - . . . .**	**DN250** **65048 - . . . . - . . . .**
1	Bonnet seal	Viton	N-5100-259	N-5100-267	N-5100-272	N-5100-277
		other materials	on request	on request	on request	on request
2	Body seal (Viton) This includes a 2ml syringe of vacuum grease		204884	206527	200468	202592
3	Gate seal	Viton	N-5100-155	N-5100-258	N-5100-266	N-5100-275
		other materials	on request	on request	on request	on request
	Seal kit vacuum (Viton). This consists of item 2 and 3.		204883	206526	204204	203883
	Syringe of vacuum grease	2ml	206792			
		5ml	206793			
4	Actuator shaft seals (Viton)		N-5111-329 (2 pcs required per valve)			
5	Sealing ring shaft seals (Viton)		N-5111-112 (12 pcs required per valve)	N-5111-112 (8 pcs required per valve)	N-5111-112 (12 pcs required per valve)	N-5111-112 (16 pcs required per valve)
6	Pendulum plate:					
	- Blank	B1 *)	91048-01	101570-01	201272	94632-01
	- Blank	B2 *)	on request	231343	226661	on request
	- Hardanodized	B1 *)	100741-01	98371-01	200500	92228-01
	- Hardanodized	B2 *)	on request	98673-01	201437	92229-01
	- Nickel coated	B1 *)	on request	on request	211613	on request
	- Nickel coated	B2 *)	on request	on request	on request	on request
7	Sealing ring					
	- Blank		216490	207518	204453	205874
	- Hardanodized		217050	204340	202046	203217
	- Nickel coated		on request	on request	211610	on request
8	Actuator	B1 *)	347193	342943		
		B2 *)	347194	346981		

*) Refer to figures on next page to check for actuator position options.

Use only spare parts manufactured by VAT to assure safe and reliable operation All “

Actuator position options:

Valve with **B1** actuator (standard)	Valve with **B2** actuator (option)
	

All “Item“ refer to chapter «Drawing»

12.1.2 Control and actuating unit

Item	Description	Part number
	Valve size **Product ordering number**	**All sizes** **650 . . - . . . .**
6	Control and actuating unit	Too many to list. Please contact VAT.
	Option board with SPS module (±15 VDC sensor power supply)	371399
	Option board with PFO module (power failure option)	371397
	Option board with SPS and PFO module	326113
	Controller separation kit including 4.5m cable	264881

12.1.3 Accessories

Description	Part number
24 VDC power supply unit (input: 100 – 240 VAC)	249775
'Control Performance Analyzer' package for Windows®	free download from: http://www.vatvalve.com/customer-service/informations-and-downloads/control-performance-analyzer
'Control View' software for Windows®	248126 free download from: www.vatvalve.com
Service cable (PC to valve Service connector)	230327 free wiring information available for download from www.vatvalve.com
Connector kit consisting of: • DB-9 female POWER plug • DB-15 male SENSOR plug • DB-25 male INTERFACE plug (for RS232, RS485 and Logic only)	242411
Service Box 2	601BS-29NN-000
Control panel (rack-mount version of Service Box 2)	602BS-29LE-000
O-ring removal tool	234859
VAT valve cleaning tool	305709

12.1.3.1 Centering ring with Viton o-ring

Description					
Valve size Product ordering number		**DN 100 / 4" 65040 - . . . .**	**DN 160 / 6" 65044 - . . . .**	**DN 200 / 8" 65046 - . . . .**	**DN 250 / 10" 65048 - . . . .**
Centering ring with Viton o-ring (for ISO-F installation only)	Aluminum	32040-QAZV	32044-QAZV	32046-QAZV	32048-QAZV
	Stainless steel	32040-QEZV	32044-QEZV	32046-QEZV	32048-QEZV

13 Appendix

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